COMMITTEE WORKSHOP

BEFORE THE

CALIFORNIA ENERGY RESOURCES CONSERVATION

AND DEVELOPMENT COMMISSION

In the Matter of: Informational Proceeding and Preparation of the 2005 Integrated Energy Policy Report Re: Energy-Water Relationship and Potential Changes in Hydropower Production from Global Climate Change in California and the western United States	Docket No. 04-IEP-01-H

CALIFORNIA ENERGY COMMISSION

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Reported by:
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I N D E X

I N D E X

P R O C E E D I N G S

9:06 a.m.

PRESIDING MEMBER GEESMAN: This is a workshop of the Energy Commission's 2005 Integrated Energy Policy Report Committee. I'm John Geesman, the Presiding Member of that Committee. To my left is Commissioner Jim Boyd, the Associate Member of the 2005 IEPR Committee. To my far right, Art Rosenfeld, the Presiding Member of the Commission's Energy Efficiency Committee and RD&D Committee.

And then between Commissioner Rosenfeld and myself, Melissa Jones and Gary Klein, my Staff Advisors.

This is a workshop designed to receive comments on two staff papers that we have prepared in conjunction with the Integrated Energy Policy Report. One, the water/energy relationship whitepaper is a topic that we have teed up for particular scrutiny in this year's IEPR cycle. And we envision that forming the core of a multiyear research and policy initiative on the part of ourselves, the Department of Water Resources and other members of the water community.

We've been quite intent, though, on not allowing either that paper or this forum to be an opportunity to relitigate water policy questions. Our focus is on energy policy. Obviously there's a fairly heavy overlap as the staff paper points out. But our intent is to confine our focus to the energy implications of water issues and allow the water policy makers in state government to focus on the water policy ramifications.

The second whitepaper that we'll be discussing this afternoon is potential changes in hydropower production from global climate change in California and the western U.S. And rather than an attempt to capsulize those issues, I think I'll simply defer them to this afternoon.

Any of my colleagues have any remarks?

COMMISSIONER BOYD: No, thank you.

PRESIDING MEMBER GEESMAN: Mr. Trask.

MR. TRASK: Thank you, Commissioner. Good morning. My name is Matt Trask; I'm the Project Manager for the water/energy relationship staff paper.

A couple of housekeeping things that we generally go through. We have bathrooms out in the corner over here. Caution you not to go out the door over there because you will set off an alarm. We have a coffee shop up on the second floor, a little snack bar, as well.

Want to give you a little bit of a schedule. I'm going to do a brief presentation this morning just covering the high points of the study and some of the things that were maybe a little bit controversial in the study.

And then we're going to be taking comments from people. We're going to start with some comments from people who have been working in our water/energy working group, which has been a valuable resource all through this study. And then we'll open it up for general comments.

We only have about three hours so we'll be moving rather rapidly. And then we're going to close up with a little presentation and a demonstration out front in the trailer that you all probably saw as you came in, which is the Irrigation Training and Research Center's -- I'm sorry, the Center for Irrigation Technology's agricultural efficiency pump testing program.

First of all, I wanted to just acknowledge that I learned a tremendous amount on this study, just amazing information, and absolutely of vital importance to the state.

I wanted to acknowledge a couple of contributors, Monica Rudman and Tom Crooks, who contributed quite a bit to the study, but whose names were left out on the credit page. And I wanted to give credit where credit was due.

Real quickly, the purpose of the study was to accurately -- primarily was to accurately assess the energy demand in the water sector. And that's everything in the water sector, from supply to end use to wastewater treatment and disposal.

We wanted to look at the ways that we could reduce onpeak and total electric demand in the water system through conservation, efficiency and developing some electric generation in the water system.

And then finally, we wanted to develop tools and programs for planners, water agencies, companies, anybody involved in the water sector, and how they can address their energy needs of new and existing systems. And that part, actually, is very important and will be ongoing. Following this study we're going to establish a clearinghouse of information on water and energy nexus, I guess you'd say, issues. And possibly a pilot program going on from there.

We have several questions this morning that we're asking people to look at and see if we've answered them. The first one is basically, did we get it right as far as our estimates of energy use in the water sector all together. And if not, what is missing.

These are the numbers we've been using all throughout this study for energy demand in the water sector. We know that some of these are almost certainly low. Treatment requirements have already started ramping up quite rapidly. This number was from a few years ago and based on an EPRI study. So we're fairly confident that it's considerably higher than that.

The end use and water supply numbers we think are fairly accurate. But the final number there, irrigation pumping, has probably been the area of most contention throughout this study, and we'll have Dan Howes of the Irrigation Training and Research Center talking a little bit about that.

But basically we'd seen other estimates that were about four times as high as ours, the Energy Commission's estimate. We think some of that, actually a lot of that is probably just the accounting that we have. The utilities report to us in certain categories; they just take their meter data, put it in categories, and say that's all the energy that was collected in that category.

Well, some of the categories allow as much as 30 percent of that energy use to be used for pumping, but we would never know that. It's just not accounted for.

Other things is we are almost certainly underestimating groundwater pumping. That's probably the biggest unknown right now, both the amount of water and the amount of energy that's used in groundwater pumping.

And then we've also seen some very dramatic shifts in crop planting patterns which also has a direct effect on use of drip irrigation and therefore a direct effect on energy.

We think it's very important to focus on the ag sector energy use for several reasons. One of them is, although the total energy use might be low, it's generally packed within a few months each year. Most intensive in June through August. And can account for as much as 4500 megawatts onpeak during those peak months. And in most systems there's very limited ability to shift that offpeak, because when the water comes down the canal you've got to take it or it's just going to overflow.

So, in effect, in the ag sector we are looking at will increased energy efficiency and land idling programs, things like that, will that offset the increase that we see from changes in crop patterns. Will the shift towards drip irrigation continue. Something like, I think, over a million acres were converted to drip irrigation since 1990. And will we see a significant increase in electric use from shifting or converting ag pumps from diesel to electric.

Next part was to focus on did we get it right when we started to predict what will the future effects be in the energy demand. We had come up with this range of possible increases. You can see that in every sector we're seeing quite a bit of potential for increase in energy use.

One thing that people have asked me about is, is this additive. Will we indeed see as much as almost 17,000 gigawatt hours. Well, my answer is that is if we do it poorly, yes. If we don't do our proper planning it is possible.

However, there is quite a bit of tradeoffs involved. For instance, in the water market transactions we could see an increase of perhaps as much as 2000 gigawatt hours there. But that also might offset some things like conjunctive use pumping or other areas. And conversely, if we store a lot more water underground, perhaps we don't have to do as much conveyance.

And here's where we see all the energy in through the water treatment system. We've seen this slide several times before. The one thing that I've added here is recycled water pumping. Now, for instance, we know that a whole lot of systems are looking to shift to recycled water, which will definitely require quite a bit more treatment and quite a bit more pumping.

However, the question is how much will that displace the distribution pumping up there in the corner, the 1150 kilowatt hours per million gallons. On the face of it, it might appear that every gallon that you pump from recycled water just replaces a gallon that you've pumped in the distribution system.

But there's a lot of other factors involved. Things like elevation differences. Most of the time your treatment systems -- if you have an elevation difference at all, most of the time your treatment systems are higher up, your wastewater lower down. So your distribution pumping is generally downhill; your recycled pumping would generally be uphill. And therefore would use a little bit more energy in the process.

It's an area that we will be continually looking at, just every year, over and over. But we also have a study, Bob Wilkinson of UC Santa Barbara and Gary Wolff of the Pacific Institute are doing a study attempting to essentially single out every single area of energy use in the water sector and to quantify it.

We expect that that will be starting to be completed later this summer. We'll have sort of the first stage of it at a workshop. And then I think it's scheduled for completion later this fall.

So, we talked -- that previous slide had average estimates, and here's what we think is actually the range of estimates for any particular water agency or agricultural irrigation district. It could be as little as zero energy use for conveyance for systems that can take water right out of the creek into their canals. And it could be as much as 10,000 kilowatt hours per million gallons at the end of the State Water Project on the east side of the Metropolitan Water District system.

Similar with treatment. If you're using groundwater that's not contaminated at all, you might have as little as 100 kilowatt hours per million gallons. If you have very contaminated groundwater, it could be much higher than that, 5000 kilowatt hours per million gallons, which is essentially the same as desalination, because the contamination can be that bad in some areas.

Similarly, distribution. I touched on that a little bit. Can be from zero, and actually there's several systems in California that have zero energy use in their distribution system, using elevation difference to drive the water. And it could be as much as 1200 kilowatt hours for systems that are very large and very flat terrain.

Wastewater pumping was an area that probably didn't come to mind, but many wastewater systems actually have little wells all the way throughout their system and it requires pumping to lift the water out of the well and into the system.

Wastewater treatment is another area that we think is going to be growing rapidly in energy use. Right now it ranges from 1000 up to 3500, again getting close to about the desalination levels.

So we see, in total, a range of somewhere between 1100 and 20,000 kilowatt hours per million gallons possibility for a given water sector. It's going to be extremely rare that you would see that much. For instance, if you're getting water from the State Water Project at 10,000 kilowatt hours for conveyance, you're probably not going to have to treat it as high as 5000 kilowatt hours. So the actual range will probably be somewhat less than that.

Again, these are ranges, and they point out that we also have quite a bit difference in regionality. Southern California having quite a bit less access to local water sources; have to transport a long distance. So they have much higher conveyance energy use than northern

California. Distribution about the same, wastewater about the same, so the total difference is only in conveyance.

Now, finally we asked, well, what can be done to improve the effectiveness of existing water and energy sector programs. Conservations, efficiency, forecasting, across the board.

Much of this is laid out in appendix D of the report. And actually that will be the part of the document that will be ongoing, continually revised. Tom Crooks of Navigant is managing that part of this study. And it's going to be the basis -- it's an avoided cost based analysis of water conservation and efficiency programs. Essentially we're trying to get the best bang for the buck out of our water conservation programs. If we can find one that saves maybe $20 in water and $20 in energy, that's probably a little bit better than one that saves $30 in water and none in energy.

There's a lot of things you can do. I mentioned conservation and efficiency. But we can also do things like innovated market transactions and so forth. And the Metropolitan Water District is probably the agency most active in this. Here we see their basic energy costs, you might say, for the various sources of water, ranging from 13,400 for seawater desalination, which is an estimate, down to just 1500 for groundwater replenished with recycled water.

So agencies, especially in southern California are looking essentially for ways that they can exchange these type of energy use and these types of water sources and reduce their overall energy use.

For instance, MWD has done some exchanges where they can give some of their State Water Project to agencies further up the system in exchange for taking more Colorado River water. And you can see there's about a 3000 kilowatt hour per million gallon difference in the conveyance of those two water sources.

I mentioned conservation. It's something that we think requires very careful planning; something that we definitely want to work with water agencies just to insure that the energy use associated with those programs is carefully planned for.

For instance, drip irrigation is probably the one that we find most disconcerting, perhaps, because, yes, it's definitely going to save water, but we think that it would actually increase energy use, which is something we're concerned about.

We're also looking at things we could do to reduce peak load in the water sector. And Lon House of the Association of California Water Agencies will be talking about that quite a bit here in a little bit. So I won't go into it too much.

Again, I mention those market transactions that could reduce the long-distance pumping. And then finally, we're going to be looking at water system generation, where can we put in tiny little hydroelectric projects right into conduits, run of the river, run of the canal type paddlewheel generators, biogas and wastewater, solar panels, you name it.

We think there's tremendous potential for squeezing out some generation out of the water system. And then also using a lot of that vacant land that a lot of water and wastewater systems have available to put in additional generation.

So, that's it, fast and furious. If you have any more questions or need any more information about the staff paper, itself, you should probably contact me. And there's my number and email.

But we also have several experts in various fields that are available to answer your questions directly in these various topics. And this handout is available out front. It's also on our website. So, it's available whenever you need to use it.

MS. JONES: Matt, can I ask you a question. One of the things that you identified on your previous slide was peak load reductions in the water sector. And I'm wondering to what extent you were able to quantify potential reductions there.

MR. TRASK: We think there's a tremendous opportunity there. Lon House has some numbers that he'll show you. We think almost immediately we could reduce by about 250, 350 megawatts. And then with some rather minor changes to the systems, adding some more sensors, essentially trying to build in a little bit more flexibility into water supply, it could easily be three, four times that amount.

MS. JONES: Thank you.

MR. TRASK: So if we have no questions right away I think we'd like to go right into our public comments. First up will be Mary Ann Dickinson with the California Urban Water Conservation Council, who has to be at another meeting in about a half hour.

PRESIDING MEMBER GEESMAN: You need to make certain your green light is on.

MS. DICKINSON: Okay. Good morning, Commissioners Geesman, Boyd, Rosenfeld, and my thanks to the staff for letting me go first so I can go to another meeting later on.

As Matt mentioned I was part of the working group that worked with him on putting together this paper. And I have to congratulate him because he has put together a very cohesive document out of the myriad numbers of meetings that we had. And I think it's a very good summary of the information that has been presented to the working group.

I think the fact that the Energy Commission has undertaken this staff paper is a very important policy and programmatic step towards recognizing the very strong connection between water and energy use. And I'm hoping it is going to be the beginning of a whole series of policies and activities from the Energy Commission.

I'm especially looking forward to the PIER-funded study by UC Santa Barbara and the Pacific Institute to further identify the energy use at the end use point; the sector analysis, and then what actually happens at the other side of the meter. I think we've never had very good data on that, and I think we may find that the energy use is actually even a little higher than has been projected in this staff paper. The more work we do the more we realize that water and energy are very intertwined.

I have four or five comments on the whitepaper, and then I'd like to close with some comments about some possible next steps that the Commission might want to take.

The first thing I want to just mention, and it's a very small little minor detail. The California Urban Water Conservation Council, the organization that I represent, is a voluntary signing on of water agencies across the state. But we increase the number of agencies on a regular basis.

When Matt started this report we were at 178 water agencies. Now we're at 189. We're continually growing. And that's actually a very good sign. Aside from a little, you know, correction of the number, what it's essentially saying is agencies are continuing to sign on to programs for water efficiency.

And as your report clearly points out, where you're saving water you are saving energy. Many of our members are in southern California, so that gives you the double hit with the water conservation program.

Second thing I want to point out is on page 64 you mentioned Metropolitan's pre-rinse spray valve program. And I want to go into that in a little bit of detail, because I'm very proud of that program. That's a program that actually is run by the California Urban Water Conservation Council; it's actually a statewide program. It's not just in the Metropolitan service area, it is all across the state.

We have already installed about 20,000 spray valves. We will be installing another 18,000 by the end of December. And Southern California Gas and PG&E have both indicated a desire to continue with the program to perhaps the point of saturation. There are about 100,000 of these spray valves in the State of California.

The message, though, that I wanted to give you with this, again, and it's not just the insertion of the statewide Council focus, it's that this is a good example of where a minimal investment in research yields an enormous amount of savings in the long run, and ultimately results in a standard by your Commission.

And I think this is actually a great model to follow for other water and energy retrofit programs.

Metropolitan Water District had an innovative conservation program. They gave $10,000 to the Food Service Technology Center to study this new-fangled spray valve. When the Council saw the results from that $10,000 study, we jumped on it and applied for funding from the California Public Utilities Commission to do a third-party implementation program. And were successfully awarded the funding. We're now in our second phase of that program and hopefully about to start the third.

The savings were so dramatic that your

body, the Energy Commission, decided to mandate a pre-rinse spray valve standard to the exact flow rate of the ones we were distributing beginning January 1st of 2006.

So, to me this is a huge success story. This is going from a $10,000 piece of research to an enormous amount of savings for the State of California.

And I think we can replicate that. We can do that with a number of different other technologies that use both water and energy. I think we need to invest in the research upfront to identify what those technologies are. And then we need to do statewide roll-out programs that get it done across the state.

Another item I wanted to just comment on in the report is that there's conversation throughout about the behavioral issue of conservation. That, yes, you might install drip irrigation, but it might not be properly managed. Yes, you might install a hot water system that reduces the wastage, but the consumer might end up taking longer showers.

A lot of this is anecdotal. The research right now does not bear out the behavioral change. The most obvious evidence of this is the residential end use study which was done by the American Waterworks Association Research Foundation. And I'll make sure Matt gets at least to see a copy of it. It costs $160, so I'm not going to actually give it to you, but I think Matt needs to see it.

It basically showed that houses that were not retrofitted as control groups, and then houses that were fully retrofitted with conservation devices experience roughly a 30 percent difference in indoor water use. And that was a documented savings independent of other behavioral phenomena of the longer showers or the supported anecdotal double flushing of toilets.

So, the data doesn't show that there is a diminishment of savings. In fact, during droughts it actually shows the reverse. That the consumer behavior is very directly influenced by messages from the utility that say, it's time to conserve, we're in a supply situation here, help us out.

So I think we also need a little bit more work on that. That has not really been studied at all in the water conservation field.

So that's an area that I think we could look at.

I took a look at appendix D, which is, of course, of great interest to me. You have used the Council's reporting database and the quantification that we've done of water savings in the aggregate to scale off energy benefit. And it's astounding how much money of energy benefit it is.

But I need to tell you that our savings model is conservative, and that it's an average. And there are many programs around the state that actually yield more water savings than we have conservatively modeled in our reporting database. And the database also does not include any water conservation from rate structures, from consumer education programs, from distribution system water loss programs. There are a whole series of BMPs that we didn't have a method for calculating water savings on. So consider that very much a low-end number.

And then finally, in appendix D, there's a footnote, footnote 9, that talks about the water use efficiency funding under prop 50. And this is of some interest and concern because on page 109 you're comparing the current energy efficiency program funding to the current water use efficiency program money.

And when you say there's 180 million for water use efficiency programs or 36 million per year, you're making the assumption that all bond money goes directly into a conservation program award.

And just to give you an example from prop 50, the urban and agricultural water use efficiency program is 120 million in the statute and in the initiative that was approved by the voters. But what really is coming out in actual program funds to the agencies will be 30 million a year for three years on the aggregated basis. So that's only 90 of the 120. The rest goes for other CalFed-related water use efficiency programs that don't directly result in implementation savings.

So that's kind of a problem, you know. You need to recognize that the water use efficiency funding has been very much a shadow of what has gone on in the energy community. And we are constantly working to try and improve that. I'm constantly on the stump lobbying for more money for efficiency programs, because I think they're very cost effective investments for the state on a water supply basis. And now clearly on an energy supply basis, as well.

So I want to just leave you with a couple of items. I mentioned about small investments in research yielding ultimately big savings in programs. Your PIER research program is a wonderful avenue to try and investigate some new technologies that we could come up with for researching.

That little $10,000 study is a perfect example of how if you look at some new devices that are out in the market, the possibility to make them mainstream and to transform the market is huge. When you legislate a standard that's automatic efficiency savings.

And it's savings that the bond payers don't have to pay for or that the ratepayers don't have to pay for. The customer does, indirectly, through the market, but usually that's absorbed over time and is a very minor differential cost.

So, I would like to encourage that we work together to identify some additional PIER funding opportunities.

Second thing is I would like to urge the

Commission to strongly suggest to the investor-owned utilities and the Public Utilities Commission that energy efficiency should be funded on the water efficiency side.

We used to have that in the early '90s. In southern California there used to be a water/energy partnership where a number of the rebate programs were cofunded by the energy and the electric and gas utilities as well as the water agencies. And that sort of disappeared in the late '90s. I think deregulation may have had something to do with that.

But we need it back. It's time to bring it back because the energy savings need to be given -- the contribution toward the savings on the energy utility side needs to be put into the mix to encourage greater efficiency programs. And, again, I think we need to sit down and come up with a practical solution for how we get that to happen.

The Public Utilities Commission funding that the Council went for was the first time we had ever had that kind of joint pairing. And I think we need to do more of that.

Thirdly, the concern in the report is

stated very clearly about peak load. And there are water efficiency programs that can help with peak energy load. Rudder-based irrigation controllers, ET controllers, especially those that can be remotely controlled during peak times and definitely turned off are an important thing to consider.

And rates, we've never really totally examined the impact that special pricing, especially for urban irrigation, can have on peak loads.

The third thing I wanted to mention was a national labeling program that we've talked about in the working group. EnergyStar, as we know, has been very very successful in transforming the market and getting the consumer to purchase the energy efficient products.

We, in California, have applied and been awarded prop 50 funds to pursue a statewide labeling program for water. And that's something that we would like to do very much in coordination with the Energy Commission. Because again, we feel if we can label products appropriately we can get those savings immediately from the consumer in the marketplace.

As you know, testing and labeling appliances is not a small task. We're potentially looking at a big program. But we would be the first state to do a statewide program with the hopes that maybe we could make it national. And I think that would be a wonderful benefit of, you know, the water/energy research that you've already started.

And then finally, I just want to leave you with the thought that conveyance is still your largest energy use, your electrical energy use. And conveyance in southern California is your biggest hit.

Therefore, it seems logical that we should be really looking at programs in southern California. If you really want to minimize the electric energy usage, we need to make sure that we're really concentrating a lot of those program dollars.

Metropolitan has been a leader in conservation. I think it actually works to their disadvantage because it's assumed that they will always be there and do that. I think that's an incorrect assumption. I think we need to help Metropolitan do more. And I think they can do more with great energy benefits.

So, if you're looking at two-thirds of y our energy growth, your electric energy growth coming from southern California, it stands to reason that that's an important place to focus.

And the Council, California Urban Water Conservation Council stands ready and willing to help put together regional programs not only with Metropolitan, but on a statewide basis. And we are firmly behind you in this water/energy connection.

So, thank you.

PRESIDING MEMBER GEESMAN: I certainly thank you very much for your helpful recommendations and all the assistance that you've provided us in this process so far. I think the interesting comment about a $10,000 research project. to juxtapose that with what we do on the electricity side, is just very difficult for me to do.

We have grown so large in terms of the research programs, both here and in the efficiency programs at the Public Utilities Commission, we have a very difficult time tracking a project that is $100,000 in size. And although it's taken a long number of years and much of the recent progress is attributable to my colleague, Commissioner Rosenfeld, we have developed a certain research industrial complex in the energy area. I think our work is cut out for us in the water area.

But hopefully our report later this fall can serve as a clarion call to the research community that this is a topic and a subject area rich for opportunity. And I certainly thank you for your help in getting us there.

MS. DICKINSON: Thank you. Just leave you with one last thought. A lot of water conservation specialists started out as energy demand managers in the '80s. And they are still coming up with really creative water/energy programs. And what we need to do is highlight those and get them funded.

Thank you.

COMMISSIONER BOYD: Thank you for your testimony. I'm going to make a comment here that I was really saving for later, but I want to build on your enthusiasm and your interest. And it may be slightly far afield, but I was saving it for Matt or perhaps at the end of the day, but since

I'm going to lose you I might make the comment now.

Buried in this report is a section that talks about the petroleum industry's use of water. And it's extremely significant, and the staff details that to some degree.

But then references in this report that the topic is going to be, you know, covered in a different report entitled, petroleum infrastructure environmental performance, which report has been published; and which Commissioner Geesman and I heard yesterday in a hearing just like this.

And I raised the question about the relationship between water use and that industry and energy use and what-have-you. And in that we have attributed to that industry fairly significant water use. I was a little disappointed at the end of the day, as today, and left a little concerned that perhaps this is an untapped area.

I did not get the sense from the industry representatives or our staff yesterday; and admittedly, I left the question with the staff, who might know in our research program that has invested a lot of money into efficiency, electrical efficiency, in the petroleum industry.

But I just want to throw out for the staff's consideration and others' consideration whether we've mined this area enough. Because I did not get a feeling that there's been a lot of emphasis on that particular industry, which is a very significant user of water and energy.

And I'm just building on your idea for PIER research funding opportunities. I'm addressing this to my fellow Commissioners, as well, who constitute the R&D Committee, right here, that here's yet another area.

I don't know if this is something that you and your Association would get into because it's so industry-specific; but I throw it on the table for everyone's consideration as something that I want to see that we follow up on. And it may or may not be an avenue that you also would be interested in.

So, didn't want to lose you and lose the opportunity to mention this. Thank you.

MS. DICKINSON: Thank you. You might want to check out the Chevron plant in the West Basin Municipal Water District, because they have converted to recycled water for a lot of their process water use.

And where recycled water is available that's an option that can and should be pursued. But they were an early leader in that; you might want to take a look at that particular facility.

COMMISSIONER BOYD: Thank you.

MS. DICKINSON: Thank you.

MR. TRASK: Very good. We're going to have a slight change in our order here, in that Lon House has requested to be next. And he'll have plenty to say about peak load reduction and other facets of the water world.

DR. HOUSE: Good morning. The short title of this presentation is, water agencies, cause or cure. But one of the things I wanted to stop and say, that this has been a very useful process that we've been through because it's forced us, and in particular it's forced me to quantify a number of things that the magnitude of a number of activities that were going on that I hadn't done previously. And that's the presentation that you're going to see today.

What this presentation, this complements what is in your report. What your report does is it deals with energy. This presentation deals only with capacity. And those are some numbers that aren't in your document.

Okay, let me just give you a summary, and then I'll go through each one of these slides individually.

Currently the water agencies, I'm talking the private and public water agencies, not including -- this excludes the Department of Water Resources -- were the single largest electricity end use in California. About 3200 megawatts of maximum demand. We have about 2800 megawatts of onpeak demand, summer onpeak demand. We're currently curtailing about 400 megawatts right now, primarily in response to time-of-use tariffs.

We have a lot of generation that's available, and we have a lot of demand response potentially available. I've estimated that we could get approximately 250 megawatts of additional onpeak demand curtailment from existing systems. This is based upon some of the studies, the technical assessment studies that we've done. Virtually every water agency we go into has 1 to 2 megawatts of additional onpeak curtailment that's available to them. Primarily through more aggressive use of their existing storage.

I just put down, we have about 1000 megawatts of -- if we were allowed or we were incentivized to put more storage available, but actually in reality you could curtail almost virtually all of your onpeak pumping with storage. So, I just put 1000 megawatts in there as an estimate.

And then we're going to talk about time-of-use water meters and rates. You guys, the Energy Commission, has a proposal before them, but I just estimated that we could get approximately another 250 megawatts of onpeak demand curtailment through customer, water agency customer time-of-use water meters and rates.

Now, as for our generation, we have about 500 megawatts of standby generators available right now. We have almost 1700 megawatts of existing hydro. It's estimated, and this is our of the report, there's about 255 megawatts of new small hydro available. We have about 30 megawatts of biogas; it's estimated 36 megawatts of new.

We have about 100 megawatts equivalent of natural gas engines, and these are pumps primarily; these are engines that drive pumps. We could put another 200 megawatts in. And we have about 5 megawatts of solar; and I've estimated that we could have about another 100 megawatts.

That's the good news. The bad news is, which is the next part of this. What I did with this was I simply took the energy numbers that are in the report and converted them to capacity using 100 percent load factor. And if you take those numbers that are in the report for energy, you end up with about 3500 megawatts of demand that we don't have, you haven't seen yet, occurring within the next 10 to 15 years. Basically doubling our onpeak demand.

This is just a summary of what the presentation is. As I said, we have about 3200 megawatts of onpeak demand; we have about 2800 megawatts of -- we have about 3200 megawatts of maximum; about 2800 megawatts of onpeak. We currently shift about 400 megawatts out of the onpeak through time-of-use rates and the use of natural gas engines. Our minimum load's about 900 megawatts. We have about a 62 percent annual load factor. Our summer demand is higher than our winter. And our summer energy use is higher than our winter use.

And we have the potential to shift additional amounts out of the onpeak period, as I've said here, about 1500 megawatts. This is just a summary. And where this graph came from, this is actually going back to 1999, this came through our -- when we were in deregulation and we were buying through direct access, this is some of the energy patterns that we saw when we were buying power for the water agencies.

And you can see, we have our maximum demand is higher than our peak demand; and our energy use varies throughout the year. It's concentrated in the summertime, which just sort of makes sense.

Okay. And the question that you asked, Commissioner, about what we need to do, one of the things, and this has been a sense of great frustration for me, is that in the Public Utilities Commission January order they approved $50 a kilowatt for technical assessment money for audits and analyses of water agencies. And $100 a kilowatt for hardware and software installation. We still don't have programs for those.

And it's been a great deal of

frustration for me because I have probably eight water agencies that I've started the process on, but we don't have a program that sets up that will guarantee that the project will get funded. And I have been harassing the utilities and harassing the Public Utilities Commission.

Because when we finish our analysis the water agency has to have about a month to mess with their system to see if they can actually curtail and actually use their -- primarily use their storage more aggressively.

We're now into the latter part of June. We still don't have money or a program set up to do either of these things. So we're going to probably miss this entire summer.

And then some of the things that the last bullet on here is that one of the problems that we've had in the past is that if you go in for refunds from the utilities, they want to look at -- they look at the proposals that you have and ask what the energy savings are.

And what we need, if we keep water in storage longer, the water agencies have to have more sensors on their system. They've got to have more control valves, but in particular one of the issues is you lose disinfectant if it's sitting around in storage for a long time, and increases the nitrification.

So one of the problems we've had in the past is we say, well, we can do this, this water agency can shift peak by using more storage. But we need more nitrification centers and we want to apply under these rebate programs.

And the utilities will respond and say, well, what energy savings are associated with more nitrification centers. We say, well, there aren't any, but we can't do the other. And so this is just an issue that's been very frustrating for me.

We can, since in the early 1990s with the Clean Water Act, one of the things it required is once water is treated it cannot be exposed to the air. And so what you see, and you guys have seen this all over California, you see these little -- they're not little, they're big brown storage tanks sitting up on the top of the hills.

Well, water is pumped up into those tanks during the offpeak or during anytime, and that's basically what we're using. Anyplace that has any elevation has storage. And urban area has storage. The water agencies are typically -- the water engineers are obviously very conservative, and they typically use it for only water deliveries. And they don't look at it as a means for storing electricity.

And so basically what it requires, it requires us to go in and do a system simulation for them, and to show them that they can meet their deliveries, maintain their pressure, have enough water for fire protection, and use their storage more aggressively.

It also -- doing this also requires additional staffing and additional sensors and controls.

So, like I said, I've estimated that we have probably 250 megawatts from existing systems if we could get the analyses done and the water agencies convinced of this, that are available very very rapidly.

One of the things that we've also talked about in this working group is that we have not been successful in getting the utilities to pay for increased storage, water storage, as an energy peak reduction investment. And the rationale sort of makes sense, because they're saying, well, you're doing this, either you'd do it anyway, or you're doing it for water supply.

But the point, and sort of a classic example is El Dorado Irrigation District. They were looking at adding another 5 million gallon storage starting in 2006. We did a technical assessment for them. We showed them, with this storage they could drop 2 megawatts out of their El Dorado Hills fresh water system. They accelerated the construction of that facility so that it became operational in May. They didn't get paid for that because we had the issue of the utilities didn't think of this necessarily as a peak reduction response.

And if we could, like I said, theoretically you could put -- if you put enough storage up out there you could curtail all of the onpeak demand in California from water pumping.

Let's go down to peaking generation. We have a new solar preferred partner program. There is a huge amount of interest in solar within the water industry. There's probably 40 or so water agencies that are interested in installing solar.

And the nice thing about water agencies, we have big loads and we have a lot of space around our facilities as buffer zones. But you've heard this and other is the problem is the reservations are closed and we have probably 35 water agencies that would like, are interested in solar. There's no place for them to even put a reservation for solar in.

Hydroelectric generation. Anytime you see one of those brown storage facilities, brown storage tanks sitting on the top of the hill, just remember the water was pumped up to that thing at sometime, and all you have to do is put a reversible pump turbine in there, and it will generate when the water comes back down the hill. So every one of those storage facilities is a potential small pump storage facility. We have a lot of natural gas engines, and we could put more in, potentially.

And then the last thing I wanted to talk about which is a little longer timeframe, which is we're sort of dealing with all of this on the supply side. If you look at the demand side, if we could get our water customers to shift their water use out of the onpeak period, that would reduce our onpeak pumping requirements. And that would require time-of-use water meters and tariffs. And I'll talk about that in a second.

This is just an interesting graph because it's one of the -- because I like it, because if you want to see a price response, look at this. And this just shows the amount of capacity that was in what's called the California DRP, demand reserves partners, based upon the price from 2000 to 2005. And this just says what we all know, is that if you offer it they will come.

And I don't necessarily want to bore you and go through this one but what we need -- the problem we've had with demand programs and particularly with investments from the water agency side, is basically the water agencies and most of the other customers in California are just being whipsawed back and forth.

Because in order to increase our onpeak demand response, you need to have additional hardware, you also have to have additional staffing. And basically the water agencies aren't interested and you can't -- it's very difficult to pay for this over one summer. And so if we don't have multiyear programs it is very difficult to get a water agency to commit to something. Simply because they've tried it before and then the next year the program changes or the price changes. And they're reluctant to invest in things unless they've got a recovery period.

And then I'll just -- I don't need to go through all that. Okay, backup generation. This is just a summary. We have over 10 percent of all the backup generation in the state's by water agencies. Water agencies are essential services. All other major treatment plants, major pumping plants and then major wastewater treatment plants have to have backup generation by law.

It has to be diesel due to earthquake requirements, because you have to have onsite fuel storage. And this has been something that the water agencies have voiced over the years. It appears illogical to us that the water agencies cannot turn on their diesel generators one second prior to the backout to prevent a blackout. But they can turn them on as soon as things go black.

And that would be something that, you know, if you wanted to change the protocol or the loading order or something like that, you know, the issue is the generators from the Air Board that they don't like them because they're dirty. But our response is they're going to be operating anyway when you have a blackout. And in a blackout you've got millions of cars sitting around idling at red lights. And if you could use them to prevent the blackout, you could potentially save significant amounts of air pollution.

I got those numbers from you guys' database, the BUGS database. I just wanted to alert you that I went through that and several things jumped out at me that make me nervous.

One of them, and this is just an example, Ventura County APCD in your BUGS database lists 60 megawatts of backup generation. They have nothing for Calleguas. An I remembered, because I was the one that got the permits for these facilities in the early 1990s. And so that's, you know, 9 megawatts out of 60 that is not in your database. I don't know how many others aren't in there. So something just to sort of be aware of.

This is a summary of our hydro generation. There's a summary of our hydro generation by size. And the potential new is from the staff report. And this is primarily small hydro, usually under 10 megawatts.

Biogas, this is primarily at wastewater treatment facilities. We have about 38 megawatts in 22 facilities. There's about 200 additional facilities. The staff report says there's an additional 36 megawatts.

We have about 100 megawatts of natural gas engines equivalent. We could put probably another 200 megawatts of natural gas engines in. And we have about -- it's actually less than 5 megawatts of solar, but there's a significant amount because we've got the space.

The generation issues. For most -- and I'm a real fan of the small hydro, because the small hydro is what we're looking at now, it's in conduits; it's completely -- it is absolutely environmentally benign; it doesn't affect any endangered species or anything like that.

But there's been a number of problems with receiving additional, putting in additional. One of those has really changed. FERC had an order on May 12th that would standardize interconnection requirements for generators under 20 megawatts. We've been waiting for that for a long time.

Because one of the problems we've had is you pay basically the same amount for a 100 megawatt generator interconnection requirement as you pay for a half a megawatt. It was making them uneconomic. So, it'll be -- we're quite pleased with that.

The second problem we have is the price of generation. Because the generators are not at the location where the load is; the agencies have been forced to sell the generators electricity at wholesale when they could sell it and buy at retail. And what we would really like is if we were allowed an aggregation of accounts for net metering like we're allowed to aggregate accounts for demand response, then you would bee a lot more of these facilities go in.

And the last one is something that's occurred somewhat recently, well, since deregulation. And that's the cost of scheduling. If you have a generator and you're selling it out into the system, you have to have a scheduler -- schedule coordinator. It costs about 6000 to 8000 a month for a schedule coordinator.

So one of the things that we're doing, Sempra Energy Solutions, and I just put this down here for your information, they're really interested in developing some of these greenfield small hydro generators.

We are working to see if we can develop a master schedule coordinator that could be shared, so the cost could be shared by a number of water agencies. Because you can imagine, if you've got, you know, 200 kilowatt generator and you're having to pay $6000 a month for scheduling coordinator, it'll never pay for itself.

This is just a summary of what's in your report. Like I said, what I did is I just went through and took the energy numbers and converted them to capacity at 100 percent load factor.

Right now we have about 350 megawatts, and this is out of some testimony that's in this docket, of existing conjunctive use. This is groundwater that has been reserved for drought use.

That 350 megawatts is in place. It is installed. You haven't ever seen it before, but it is connected and is ready to go. Because it is set up for use during drought years, which we haven't had in basically most of this last decade.

There is -- it's very difficult, if not impossible, to get more surface storage, so if you're looking particularly in southern California, they're looking at increased conjunctive use development. If the plans come to fruition, that's another 1350 megawatts of demand.

Now, these two are real problems because they're very erratic, because they will only occur, and what they will occur is they will occur during the perfect storm. They will occur during a drought and they will occur during onpeak.

Most of the years, if you get normal years or wet years, you'll never see this demand. Because it's just sitting there. Because the water's sitting in the ground and they don't pump it out. They just use the regular pumping.

So you have probably 1500 megawatts, or you could have 1500 megawatts of onpeak demand that you've never seen before and you only see during drought years.

PRESIDING MEMBER GEESMAN: How much of that 1350 would you attribute to southern California?

DR. HOUSE: Well, I would say at least three quarters of it or more is southern California. There are plans up and down the Valley for using those, a lot of them for conjunctive use. But they're not pumping very far, you know. The water level in the Valley is pretty shallow. So they're not pumping very far. It is the southern California facilities that are at least three quarters of that of the new.

The existing is primarily -- the existing is at least over half northern California, Semitropic and Arvin-Edison and those in the southern part of the Central Valley.

PRESIDING MEMBER GEESMAN: Right.

DR. HOUSE: Desalinization, you not that I have twice the amount of capacity occurring from desalinization. And that is -- desalinization will never be a major provider. It will be an incremental provider. But it is basically the only source of fresh water, of new water that we have in the state.

And the energy savings or the water savings, I think, are very optimistic in some of the state plan, and so I put 250 megawatts. Basically I doubled the amount because I also put it in desalting, not desalinization.

Electrification of ag diesel pumps. This is from information that we got from AECA, Agricultural Energy Consumers Association. If you take the existing ag diesel pumps and you electrify them, you're going to get about a 350 megawatt increase in demand.

Water treatment. Increased water treatment is 160 megawatts. Water marking 230. And recycled water use is about 680. We do not know what the drought or climate change impacts will be. And we don't know what the increased population impacts will be.

One of the things that the water agencies are very interested in is time-of-use water rates because we don't have them. All water in California, if it is metered, is volumetric. Because as you know, there are a number of water agencies throughout, primarily in the Central Valley, including Sacramento, that don't even have meters. Their customers don't even have meters.

So, we don't have any time differentiation of water rates, which means there's no incentive for a customer to shift their water use out of the onpeak period. If we can get them to shift their water use out of the onpeak period for landscaping or for whatever, that will reduce our pumping requirements during the onpeak.

There's a number of issues. Time-of-use

water meters don't exist. We don't have time-of-use water tariffs. We don't know quite how to integrate them with the existing metering and billing. We don't know how the customers are going to respond. We don't know what it's going to cost.

And we have a proposal for a demonstration case before you guys, the Energy Commission. It has not been funded yet.

Okay. Now, I'm about closing down. This summer if you free up the technical incentive money we could start doing some of these studies and getting the water agencies to look at using their storage for energy management.

But we also need to allow the financial incentives to be used for non -- what looked like nonenergy-related technologies.

For the longer term, if we could get a policy in place that would allow incentives for water agencies to reduce their onpeak through things that they need to do, either increase storage or increase operation controls of their system, that would be a great help.

If we could break open the reservations for the solar rebates you would see a lot more water agencies putting in solar. If we could get aggregation of accounts for generation, like we have for demand response, you would see additional small hydro going in in the conduits.

And one of the things I want to recommend is that you would pursue the time-of-use water rates. Because -- and Mary Ann was talking about this -- it is more expensive than her proposal, but basically the water agencies don't have a choice, you know. We sort of -- they're sort of like the electric utilities in that we supply water whenever the customer demands the water.

And right now we're just all looking basically on the generation side. And there are no incentives. And there's really no way to get into the demand side, to get the customers on a program that will encourage them to shift water use out of the onpeak.

Let me just give you an example of that. If you've ever traveled in third world countries, not that I'm recommending that California become a third world country, but what you'll see is you'll see on top of almost all the buildings, particularly in the Middle East, are problems with

-- they either have water problems or electricity problems, you'll see tanks on the top of the buildings.

And that's because if they have electricity problems or they have water problems, they pump whenever the water is there, the electricity is there. You don't see that in California. There are no incentives for that in California.

But it is very cost effective for if you set up the right tariffs on the water side for a building or a house, to put these tanks up on their property and basically control their water use. There are no mechanisms now for us to do that, because we don't have any time-of-use meters, we don't have any time-of-use tariffs, we don't have any billing that's associated with that.

Also talked about generation; talked about demand response. Echo what Mary Ann said, the water savings measures are evaluated on water savings, cost effective energy measures are evaluated on energy savings cost effectiveness. And in the past we haven't been allowed to mix them.

But I think that you guys are really going down the right path. If we can quantify those and get credit for both of them, there's a number of additional measures that may make sense.

Customer demand response needs to be investigated. Time-of-use water meters. And then we are actually have been heightened sensitivity to the energy impacts associated with new development and new regulations.

One of the things that we would ask is that if it -- for those areas that enter your purview the energy costs associated with water treatment are not considered. And it is something that we would like and we would recommend that people start considering when they develop new regulations.

Because the new regulations for particularly water treatment, if you look at arsenic and you look at uranium and a bunch of these others, those are developed absolutely independently of any impact on the electric system or costs necessarily associated with developing and doing that water treatment. That would be a great thing if we could get the treatment requirements to at least look at what the energy impacts are going to be.

Okay, that's my presentation. You got any questions?

PRESIDING MEMBER GEESMAN: Lon, thanks, again. You have greatly helped us over the course of the last year in pursuing this. And I certainly am appreciative of the degree of contribution that you've made.

Commissioner Rosenfeld.

COMMISSIONER ROSENFELD: Lon, I want to resonate with you on the time-of-use issue. And just to make a point, the first place where time-of-use has, of course, become pretty obvious or the need for it is in electricity.

And as you probably know, all of the California independent IOUs are going to -- have applied to put in time-of-use electric systems. And there will be communications networks.

Those electric systems, of course, are going to relay information from gas meters. But there's been very little discussion of relaying information from the water meter for a building, for example, which is pretty close.

It seems as if a good PIER project would, in fact, be a pilot of some sort working with pumping, so in the south land with Edison or San Diego or conceivably LADWP. So we should indeed talk about that.

DR. HOUSE: Yeah, you have a proposal before you that will do exactly that. Will develop the protocols for the time-of-use water meters and do a test case. We had Coachilla and Southern California Edison that were willing to do that. Now, that's before you guys.

But one of the things, one of the problems that we'd run into is that the water meters, the electric and gas meters are usually pretty close. The water meters usually aren't. The water meters are usually sitting out by the street.

And so what we may end up doing is developing independent water meters, time-of-use water meters. But right now they basically don't exist, particularly for the small ones.

But I agree with you, if we did not have time-of-use options on the electric side, we could not manage the electric system. You're asking us to manage the water system with no time-of-use information or time-of-use response on the water side.

COMMISSIONER ROSENFELD: Good, well, let's pursue that further.

DR. HOUSE: Okay.

MR. TRASK: I also wanted to add my personal thanks to Lon. And actually, I would recommend if you ever want to redo this report, just have Lon do it. It'll get done in about a week or so.

(Laughter.)

MR. TRASK: Our next speaker is Dan Howes with the Irrigation, Training and Research Center, who will be talking about agricultural pumping.

MR. HOWES: My name is Dan Howes. I'm with the Irrigation, Training and Research Center. I'm a Senior Engineer with the ITRC. We presented some information at the first workshop, and I'm just here to present some more comments on the WER. It was a pleasure working with Matt and the WER group. We're glad to see our information and a lot of our insights were put into the report.

The focus on the comments are on, again, ag water, energy use. I'm going to introduce some additional material and analysis to the Integrated Energy Policy Report process for the CEC here.

Again, we're very pleased to have been -- to have helped in this WER process with data analysis from the research that we've done with the PIER ag program.

The first clarification that I'd like to go through is regarding total electricity used for water in agriculture. This is WER report page 29 which acknowledges that its estimates for agriculture related to irrigation electricity use is likely too low. Which, from the table that Matt showed earlier, it was about 2260 gigawatt hours per year.

On the next slide I'll show a table showing other estimates from the CEC, as well as from independents such as ourselves and the University of California. But in order to come up with a better number in terms of electricity billing estimation of irrigation pumping we recommend that a more comprehensive effort be conducted to develop a rigorous data collection and analysis process to generate new, more accurate agricultural water/energy use baselines.

This includes working directly with the ITRC and the utilities to look at the breakdowns of current utility record numbers and establish a more comprehensive procedure to actually categorized what the electric accounts are in the ag water sector.

This table was created by myself and Dr. Charles Burt in a memo that we sent to the California Energy Commission. This memo, I think we're going to put it into the docket and make it public record, so that everyone can look at the entire memo.

But this little table shows the differences that are out there, within the CEC, itself, as well as with independent estimates of what actually agricultural irrigation water pumping is.

We can see the 2260 number that's used in the report. But also acknowledge that as being likely too low. Some other estimates from the CEC ag water energy forecasts. The next code data for actually a different year showing the energy breakdown.

The original University of California report which was done in 1977 showing about triple what the categorized energy use is. But also missing certain components.

An updated version of the UC report that takes into account the increase in drip micro irrigation systems requiring additional pumping, as well as decreased the pumping plant efficiencies over the last 25, 30 years.

And then our report numbers which show both of them fairly reasonably close at around 10,000 gigawatt hours per year of energy use in the irrigation water sector. Now, this, again, takes into account groundwater pumping by irrigation districts, by farmers, surface water pumping by irrigation districts and farmers, as well as conveyance through State Water Project's facilities, Delta-Mendota Canal and areas like that, specifically for irrigation water.

The next clarification on page 3 which quotes, data is quickly outdated because of rapid changes in planning patterns and response to crop price dynamics. The ITRC understands about crop price dynamics, but we have other major factors that can influence the potential increase in electricity use for groundwater pumping. And we recommend that these be added to the WER report.

These include a shift in drip micro irrigation systems at the farm, which are now required to use groundwater instead of surface water, in order to get more flexible irrigation deliveries.

Again, with drip micro you may want to irrigate every day, every other day, as opposed to every two weeks with your surface water supplies. A lot of irrigation districts don't have the infrastructure to allow this to occur.

We are currently working with a number of irrigation districts to improve this, what we call modernize. But it's still a huge problem.

The next area is -- this is just an example, but right now there's a San Joaquin River court case which has plans to rewater the San Joaquin, taking water from the irrigation or agricultural side and putting it into the San Joaquin River. How's that water going to be made up? Initially the crops aren't going to change, so it's going to be made up with groundwater pumping.

And then, as Matt said, a larger than expected shift from diesel to electric motor driven pumps, again causing, we think now, well, estimates out there independent of my own agree with my own which say about right now 83 percent of all groundwater pumps and surface water pumps on the onfarm side are electric. So 17 percent are other. We see a shift back. Last time I gave a presentation we made some estimates of how that would influence the electricity usage in the future.

Third clarification on page 56 of the WER report: Quote, "Pumping efficiency improvements do not reduce energy consumption. We just want to point out that this generalization only applies to onfarm well pumps. It does not apply to irrigation district and onfarm booster pumps. It also does not apply to farms using, I quote, "more scientific water management practices" or irrigation scheduling techniques.

Basically what the generalization means is that if a farmer improves his efficiency he's actually going to pump more water, not reduce the energy use. He can pump more water with the same amount of energy that before he had the efficiency improvement he could do so.

What we're saying is on irrigation district and onfarm booster pumps, they're only pumping a required amount of volume. So if they can pump that volume with increased efficiency, they will save energy.

The next section that I'd like to go over are additions to the WER report, or recommended additions to the WER report. We noticed that our portion or the portion of the California Energy Commission ag peak load reduction program that was actually administered by the Irrigation, Training and Research Center for irrigation districts was not discussed in the WER report.

Our portion alone achieved peak load reductions of over 43 megawatts throughout the state. We identified high potentials for irrigation districts to shift peak load using pump storage techniques as well as other innovative solutions, and participate in demand response programs.

And we actually developed the pump testing procedures and standards used throughout that program and in other programs that are still in use today.

The next recommended additions to the WER report are also things that I went over in the first meeting. But to readdress our recommendations addressed irrigation-related electricity consumption from the PIER agricultural program's technology roadmap.

This roadmap placed emphasis on really five different areas. The first one is more emphasis to improve irrigation district infrastructure. Again, to reduce the groundwater pumping on farms that now have to use drip -- groundwater for the drip microsystems.

New pump designs --

PRESIDING MEMBER GEESMAN: Let me stop you and ask you to elaborate a bit more on what type of infrastructure you're talking about.

MR. HOWES: Sure. In terms of irrigation district infrastructure to improve service to the water users, improve their flexibility of deliveries, what we're looking at for open-channel system, canals that are out there, new types of cross-regulating structures that allow the district to change the flow rates without needing manual operation of each of their gates. That reduces the time that it requires for a water change to move down.

It also incorporates regulating reservoirs throughout the system. That was, if a change is needed at the tail end, they don't have to wait 24 hours for a change to be made.

These are just some types of examples. What we've seen in the projects that we're working with right now is that this can dramatically improve the delivery service from a rotational system, which is still widely used in California, where water users can only get the water every 14 days. And they have to take the water; they have to take it for so many hours.

So we're trying to move to a more arranged system where they can call in 24 hours in advance notice, say we need the water for this amount of time. And if they don't need it for that total amount of time, they can call up their ditch rider and say, hey, we'd like to shut off a half an hour or an hour earlier. Can you handle that. And him being able to say, yeah, we can do that. Really conserving water, conserving district operational spill, as well onfarm tailwater spill.

The second category was in terms of new pump designs to help keep the pump efficiencies high at different water level changes, things like that. Basically to improve pump efficiency overall.

Ways to reduce pumping pressures, drip

microtechnologies. Again, if we shift to drip micro, we expect to see an increase in energy demands with today's technology. But, you know, tomorrow's another day. And if we can invest in research and development of new technologies that require less pressures to deliver the same distribution uniformity, the same water, we won't see as high of an energy increase.

So, new sprinkler options, again to conserve water and power; more durable pump impeller materials that won't wear out with time. Things of this nature are outlined in the PIER technology roadmap.

Finally, I'd like to discuss some of the recommendations of the potential measures to achieve water/energy efficiency. These include, the first one, in terms of peak load reduction options, achieve peak load reduction options in large pumping systems by encouraging irrigation districts, large farming companies to participate in demand response programs. I'd like to add, as well, pump storage programs and other innovative solutions that can help reduce peak load even on a daily basis.

And achieve, as was discussed a little

earlier, achieve peak load reductions by encouraging accounts to adopt time-of-use rates. Time-of-use rates aren't required on smaller pumping installation, so encouraging that can actually help reduce peak load.

In terms of energy conservation and efficiency, encourage irrigation districts to adopt flexible water delivery systems. I hit on this. This is the third time I've hit on this today, so as you can see, we feel it's a big issue and it's something that should be looked at.

Encourage farmers who utilize micro systems to actually purchase the flexible district deliveries once the irrigation district has improved their infrastructure. And also encourage regional coordination efforts to adopt sustainable groundwater energy management practice.

The ITRC is proud of the work we have done with the CEC, thanks to over 16 years of partnership, to advance energy efficiency in agriculture. If you'd like any more information you can -- please feel free to contact Dr. Charles Burt, the Chairman of the ITRC, or myself.

Again, thank you very much for your time. Any questions?

PRESIDING MEMBER GEESMAN: Thank you very much. I found your comments extremely helpful. And, you know, we're talking up here about the process that we'll undergo in terms of finalizing this report.

We've had a practice before really of leaving staff reports in draft form and not finalizing them. But I think on this one we're going to want to make an exception to that, and create a final stand-alone staff report here. And Matt's learning this for the first time, I think.

(Laughter.)

PRESIDING MEMBER GEESMAN: But I did find your comments extremely helpful.

MR. HOWES: Okay, thank you.

MR. TRASK: I did want to add, addressing a couple of things that have been mentioned by other speakers, we do have a couple of people here from our Public Interest Energy Research programs. And assuming we have time at the end of the session here they'll give a couple of very short presentations on what's going on in the PIER programs for R&D -- research, development and demonstration projects addressing these issues we've been discussing.

Our next speaker is Steve Lewis with the Arvin-Edison Water Storage District.

MR. LEWIS: Good morning, Commissioners. Thank you very much for this opportunity. I'd like to also thank Matt Trask for the excellent work that has been done to date.

I am the Staff Engineer for Arvin-Edison Water Storage District. Arvin-Edison is a conjunctive use district located in the southeast end of the San Joaquin Valley. And our primary mission is to balance groundwater conditions by delivering a Central Valley Project division contract water supply to farms, either directly or via groundwater storage and recovery.

We also participate in water management exchanges to further regulate that Friant supply. And our experience has demonstrated that it's an energy intensive process.

Since 1997 we've adopted a policy of utilizing unused capacities, that's idle spreading basins, idle wells, under-utilized canal capacities. And an extensive available groundwater storage space in the subsurface for the purpose of banking projects and water management programs with other agencies. And one in particular, Metropolitan Water District of Southern California.

This sets up a situation that I'd like to describe to you now. And it's anecdotal, but it does perhaps bear, and I think it does bear, on the issues at hand.

In November of last year, 2004, we were banking a portion of our Friant supply at the same time that we were pumping more wells. We were extracting groundwater and percolating -- the well fields in the basins occupy essentially the same space on the ground. We have 1500 acres of spreading basins and the wells are scattered throughout those 1500 acres.

So, picture this. You have a well, several wells running 1000 kilowatts per hour per acrefoot and full basins right there, ten feet away -- well, 35 feet away. Logic dictates that you turn off the wells, conserve the energy, and let the water flow by in the canal, thereby delivering that surface supply that was destined for spreading, rather than using those wells. This affects, essentially an exchange at the surface. You don't physically run the water through the process, but on paper everything's taken care of nicely and neatly.

But this is the very thing that we could not do without being in violation of state regulations.

PRESIDING MEMBER GEESMAN: I was going to say, you're obviously not a lawyer.

(Laughter.)

MR. LEWIS: I'm not a lawyer. But our lawyer did review this document before I -- I've made a few changes since; hopefully I won't get us in trouble as a result.

Because of its interpretation the State Water Resources Control Board, as I understand, has an interpretation of these place-of-use regulations that follows those water molecules. And once they have a color on them, they will forever be that color. Rather than water balances, themselves.

And so these place-of-use restrictions dictate that CVP water cannot flow to Los Angeles. On the other hand, the Bureau, while it does recognize exchanges, still all those actions and those transfers and exchanges are subject to those place-of-use restrictions. Fine.

And Arvin would oppose any action that

would weaken, change, modify or fail to honor those place-of-use requirements. But we think this archaic interpretation of this following the color of the molecule needs to be revised.

Granted this incident occurred in November. It was an offpeak month. But it's just as likely to occur in the summer. It could occur anytime.

And it occurred to me, also, how many opportunities are there to affect this type of an exchange and save energy, but we don't even think about doing it because we know we've got this restriction hanging over our heads.

The public somewhere incurs the cost of this what we think is an outmoded interpretation of an otherwise, well -- of a legitimate regulation. We're not taking issue with the regulation at all.

I think this issue is pertinent to question five in the staff paper, the Water/Energy Relationship, that's presently before us. Serves as one example of an institutional limitation to energy conservation.

And as I read through the document I noticed also that it pertains to reoperation issues mentioned on page 100. And as indicated on page 52, many transfers and exchanges carry with them an increase in energy use. But this has just the opposite result. Either planned or opportunistic, we think real-time operational exchanges could be significant in the future.

Again, I'd like to thank you for the opportunity to present this somewhat anecdotal example. And if you have any questions, I'm certainly welcome to answer them.

PRESIDING MEMBER GEESMAN: Thank you very much. I did have one question that is probably more financial related than anything else. I'm not certain it's a question you're able to answer, but in pursuing the various improvements that you have at Arvin-Edison, have you incurred debt in order to do that? Have you sold bonds to do that?

MR. LEWIS: Not bonds. We have a prop 204 loan for the construction of some new basins. And we've also obtained some grants in the process of doing some of this work. But for the most part this project has been self-funded.

PRESIDING MEMBER GEESMAN: Okay, thank you.

MR. LEWIS: You're welcome.
MR. TRASK: Thank you. Next up is Bob Wilkinson with UC Santa Barbara.
DR. WILKINSON: Thank you. I've got just a few comments on the document, itself; and then I can follow up with staff.
It's a pleasure to be able to comment and compliment, first of all, the California Energy Commission, the Staff and the Department of Water Resources. I want to say again, I think I said the last round, I'm really quite pleased to see this formal collaborative and integrated planning taking the idea of integrated planning to a new level.
I think frankly we're just getting started in some ways, and yet I think we need to honor that for on the order of 15 years staff here at the Energy Commission has been doing some very good work on the energy/water links. I'm not sure it's all as reflected in the document before you as it might be. I think there's probably more knowledge and wisdom to be mined out of your own staff here and others. And I think we need a process to continue that. So I would hope this is kind of the beginning of a process as we go

forward.

I want to go right to your key findings and just make a few comments on that, and then I'll submit kind of editorial bits throughout.

The first is if you go to page 8, key findings are listed there. There are five of them. I'd like to suggest you go to item 4 and make that the first key finding, and really make that a key overriding consideration for this. Significant cost effective opportunities, indeed some of these are profitable opportunities, exist to reduce water sector electricity, et cetera.

I think on top of that it's important to emphasize the multiple benefits and the fact that when water is used more efficiently, for example, in southern California as we've gone through presentation, you get a double benefit. You get the end use benefit, but you also convey that much less water on the margin through those interbasin transfer systems. And so you pick up that energy savings, as well.

That is a significant methodological point, and when we think about policy, we think about incentivizing efficiency in different ways in different parts of the state. That's quite a significant benefit.

Next, I'd ask that you consider public/ private investment, as well. We've got water agencies, we talk about, for example, in item 5 there, and the credit they get. But we also have end users, both public and private, that need to be included in that calculus, as well.

I'm skeptical, frankly, about item one, electricity use could double by 2015. That may be true. We've seen some reasons why that would be true. But we have the flip of that, which is the cost effective opportunities. And so I think my sense is that the more correct finding is that this could go either way. That we could see substantial increases in energy demand, both onpeak and in general.

We could also see significant shifts the other direction. And I think the interesting point there is that comes, in part, to policy decisions that will be made here and elsewhere which direction. But I think we really do have some choices of which way that's going to go.

Item three, I think we'll talk perhaps more this afternoon, as well, but I'm going to urge that we break apart drought, extended drought, shift in precipitation patterns, which is really quite a different thing, and more rain and less snow. Each one of those is a different item.

The rain versus snow has to do with warming and dynamics in the Sierra for snow pack; it's very important. That is different, in fact, that precipitation patterns. Some of the models are showing quite interesting potential shifts in those patterns that have nothing to do, in fact, with rain versus snow.

And then drought is a dynamic that we need to plan for. We already have that problem with managing California water.

Each of those is going to be different in terms of the energy implications. So I think we need to take a harder look at that; consider breaking those apart.

I want to then make one comment on the R&D. I think this needs some further discussion as well, but I think the real focus sharply needs to be on the efficiency opportunities. There are huge opportunities, as you've heard, to pick up on Commissioner Boyd's point on the petroleum industry. In the water world that falls into something called CII, commercial, industrial and institutional water use. And, indeed, I think it is a very rich area for potential improvements, the petroleum industry, among others, processing.

Some of the studies, Metropolitan Water District did a very interesting study a few years back, and indicated tremendous potential for water and energy efficiency improvement in that sector. So I would encourage you to take that further. I think you're on the right track on that.

I think I'm going to just hold there with those points; take any questions you may have back of me. And then I'll submit written comments, editorial in nature, on this.

PRESIDING MEMBER GEESMAN: Bob, I want to thank you for both your comments today, and the help that you've provided the group here the last several months.

And I'd encourage you, I'd very much like to see the report broadened to pick up some of that historical contribution that our staff reports have provided over the years. So, the more you could call our attention to that, the better off I think our end product would be.

I'd also say, you know, at the risk of antagonizing my two colleagues, that I think the message to you and to other policy analysts in this field, over the next several years, should be that we have more money than we know what to do with. And we need some pretty strong external guidance and impetus to properly deploy those resources.

We want to do that in collaboration with the Department of Water Resources. We want to do that in collaboration with other institutional actors in the water field. But, resources over the next several years should not be considered the primary constraint. It's intellectual inventiveness and ability to bureaucratically follow through.

So I want to kind of put that back on your shoulders and on your colleagues' shoulders to force us to do what you'd like to see us do.

DR. WILKINSON: Good, thank you. I'll take that challenge.

COMMISSIONER BOYD: Bob, I want to just echo Commissioner Geesman's thanks to you. You and I go back a number of years, and I've appreciated always your contribution in this subject area.

I think your point is very well made on

item 4, should be item 1, if we're going to be consistent with our other public statements about efficiency is job one. Efficiency, efficiency, efficiency in all three legs to the energy stool is what we have in the Energy Action Plan, et cetera, et cetera. So, it's a good point of communication.

Secondly, I agree with you, your points about in number three those are really three separable issues. And I mean I just sat here and reworded the sentence based on what you said. Because those of us, including yourself and I, who have spent a lot of time on climate, know that this is the way we talk about it.

Thirdly, your point about public/private investment I think is a point well made. But building on what Commissioner Geesman just said, I'm kind of throwing things back or saying we need to work together, just reminds me of the value of public/private partnerships. And I know you're in the public sector, so to speak, but you're not resident here at the Energy Commission.

And I think we can effect a lot of what Commissioner Geesman was saying if we form some more working groups; constitute them as public/private partnerships in the sense of at least cooperation; get more stakeholders involved in some of this, and do exactly as Commissioner Geesman was saying.

So I look forward to your being involved in this. And I'm sorry Lon had to leave, but he and I go back several years to when the electricity crisis and we started talking about these things. And I bit my tongue during his presentation because I'm disappointed that a lot of the things that have been talked about for years and were identified four to five years ago, and were introduced to various bureaucracies, still haven't moved very far.

So, I agree with Commissioner Geesman, we got to light a fire under this and get some of this moving. And really look forward to your participation, along with others. Thank you.

(Teleconference interruption.)

MR. TRASK: Excuse me, somebody on the teleconference, we're hearing your greetings to your neighbor or something.

DR. WILKINSON: Let me just acknowledge, too, I went to the Art Rosenfeld school of efficiency and a lot of my thinking has been very much influenced, Art, by your ideas early on, and then applying them to water. It seems like there's a very consistent opportunity here carrying the energy lessons through the water and then cycling back again.

COMMISSIONER BOYD: He carries our torch for us.

DR. WILKINSON: Thank you.

PRESIDING MEMBER GEESMAN: Thank you.

MR. TRASK: I also want to pass on my personal thanks to Bob. He spent pretty much his entire Memorial Day weekend reviewing the study and talking with me about it on the phone, and with Gary. And identified quite a bit of fuzzy thinking that we hopefully mostly eradicated out of this.

We have a few more speakers. Those of you who would like to speak, but haven't informed me, we have some blue cards out in the front. If you could just really quickly jot down your name and your agency, and pass those off to me. We'll get you in the queue here.

We have three more that I know of that will speak. Christiana Gruber, is she here? With Metropolitan. There you are. With Metropolitan

Water District.

MS. GRUBER: Good morning. Thank you for inviting me to speak on behalf of Metropolitan. And it's nice to finally meet you, Matt.

The focus of our comments today is to work cooperatively with you and to work cooperatively with some of the interested stakeholders.

Metropolitan places a high priority on its ability to provide reliable supplies at a reasonable cost. And fundamental to that is competitively priced and stable energy supply. And so towards this goal, that will get us there.

And what we're looking at doing is partnering, and we're looking at the possible opportunities to partner with the California Energy Commission on three main areas.

The first area that we have highlighted in our comment letter is related to the State Water Project. Developing comprehensive strategies. And I'll go into a little more detail on what those strategies, or potential strategies are.

Secondly, on any types of energy

recovery that we can get, research jointly. And lastly, water conservation.

Related to State Water Project comprehensive strategies, we're looking at three main areas. And we would like to partner not only with the CEC, but also with other state water contractors, Department of Water Resources. And to look at capital improvements on the State Water Project; cost effective water management programs like Steve Lewis had alluded to, that we have a partnership with Arvin-Edison.

And also in the FERC relicensing efforts, we would like to jointly become a vocal proponent of during pump generation. And I think in a previous type workshop you had heard a presentation from DWR related to that. To be a balancing voice and complement fishery and environmental issues related to pump generation.

On energy recovery we'd like to jointly research energy recovery opportunities, whether it's on the State Water Project, whether it's within our own facilities.

And lastly, on water conservation there's two areas. We have a very successful strong water conservation program. It's a regional program. In terms of the incentives that we provide, we budget $15 million a year for our incentives. Of our 26-member agencies, many of them provide a supplement incentive for rebates to the end user. And that partnership achieves both energy and water savings.

Also related to water conservation, we would like the CEC and Metropolitan once again to jointly partner up and develop and implement new appliance standards that benefit both water and power efficiencies.

So those are our overall comments.

PRESIDING MEMBER GEESMAN: Well, thank you very much for being here today, and for our continuing engagement. I do think we should search out some opportunities to do things together.

MS. GRUBER: Okay, thank you.

MR. TRASK: Our next speaker is Larry Dale.

MR. DALE: I work at Lawrence Berkeley Labs and at Climate Change Center at UC Berkeley. And I just wanted to say I think this is a great topic; I love the issue of interchange of energy and water. And I like the snapshot of the issues that were portrayed in the Energy Report, Water/Energy Report.

The only thing I wanted to add to it is that I think there's an opportunity in the future to look at possible changes in energy use associated with water as relative prices of water and energy change.

Right now we're seeing a rapid increase in energy prices, and that's liable to last for some time. Given that forecast, we can, and are doing some predictions of changes in likely water sources that will accompany changes, relative rises in energy prices.

For example, as energy prices go up desal looks not so good and conservation measures like more efficient washing machines start looking much better. Interestingly, reservoirs are fairly insensitive to the changes in prices. That's because reservoirs both generate electricity, and to get the water to users, require a lot of electricity to pump over the Tehachapis.

And at the same time one thing I'm looking at in particular I think is an interesting issue having to do with water storage. Some of it was brought up before. Looking at peak power demands that will likely arise as we do more conjunctive use.

I think more generally speaking for water storage both in reservoirs and in aquifers, there's a general tradeoff that might be considered in a future issue of this report, or future studies, to think about this. As the relative price of water goes up, let's say, as associated with climate change, you're liable to see a much more intensive use of aquifers, a drop in aquifer levels and a big increase in electricity needed to pump water from aquifers. That's one side of the picture.

There's a similar story that can be told for reservoirs. There are constraints on how we operate reservoirs, but in general to increase water supplies coming from them, let's say in anticipation of changes due to climate change, less snow melt, the need for more storage, we're liable to change flood control restrictions in certain ways that will help us adapt.

Now what this can do is both generally lower reservoir levels in order to accommodate possible big inflows during wet years. And it will also likely decrease long-run hydropower generation in much the same way, if you think about it, as the picture for aquifers.

So this is generally a tradeoff, I think, between water supply from storage and electricity either generated or required from storage, that we could be looking at as a way to anticipate future changes in demand in the future. And this issue about water storage is one good example.

PRESIDING MEMBER GEESMAN: I guess I'd raise two questions for you, not necessarily to be answered today. But one is your general sense of what the influence of a time dimension in water rates would mean.

We've struggled with that for 30 years in the electricity side, and I think thanks in no small part to Commissioner Rosenfeld, we may be on the brink in a meaningful way bringing a time dimension to electricity rates.

Let's assume that we don't beat around the bush for as long on the water side. And, in fact, over a much shorter period of time, a time dimension is brought to bear in water. What do you see as the likely ramifications of that development?

MR. DALE: I guess I don't have a ready answer for it. I mean, I'm an economist; I love the idea of time-of-rates metering.

Until now, the cost of water meters in much of the state has prevented even any kind of water meter. So, getting my mind around time-of-use meters is another step. But, I think it could work together with time-of-use electricity meters in ways that we're just beginning to understand. And so there may be hidden, just like a general theme in a lot of this work has been there are sort of hidden benefits that you uncover as you look at both resources together. And that may be the case here.

PRESIDING MEMBER GEESMAN: Second question starts from the electricity side. And although I think we will be tested over the next several years, I do believe that we made a fundamental and irrevocable commitment to a larger reliance on renewable resources in our electricity generating system.

And much of that resource is likely to be wind generation, which we're told in many parts of the state, doesn't have a very good coincidence with peak. Instead it's more likely to be available during nighttime hours, and oftentimes during the winter or spring when our electricity demand is not very high.

That would suggest to me the opportunity and perhaps necessity of making greater use of the water system for electricity storage. And do you see any likely conversions of our interest in intermittent sources of renewable electricity and storage opportunities on the water system?

MR. DALE: I think I ought to try to get back to you on that.

(Laughter.)

PRESIDING MEMBER GEESMAN: Okay.

MR. DALE: I don't have a ready answer, but it's an intriguing question.

PRESIDING MEMBER GEESMAN: Thank you very much.

MR. DALE: Yeah.

MR. TRASK: Well, to do the bookends of the two national labs involved in our water/energy relation working group, we have Elizabeth Burton with Lawrence Livermore National Lab. And she's also with the Energy/Water Nexus Team.

DR. BURTON: I just wanted to make you aware of a federal roadmapping and reporting activity at the energy/water interface that complements this CEC effort.

And the CEC paper, which includes the needs of the water sector for energy for water delivery and to insure and restore quality of water, there's a flip side to that equation which is that energy also needs water.

And even apart from hydroelectric generation, electricity production requires sustained flows of large volumes of water for cooling in the power generation process.

And increasingly across the country there have been many news reports of power plant curtailments and permit denials because of water-related environmental concerns; water shortages, particularly with the extended drought; and competing demands for the same water that these power plants need.

And these and other events have awakened Congress and the Department of Energy to the importance of the energy/water nexus. And there is some concern by these two bodies that these interdependencies between water and energy may actually be a critical factor in our future national energy security.

So Congress, in this context, has requested that the DOE actually roadmap and report to them on issues at the energy/water nexus. A team of 11 national laboratories, that includes the two California labs, Livermore and Berkeley, will be participating in these roadmapping efforts. And Livermore and Berkeley have also been working with the CEC team on this study.

And we think that the CEC paper and the efforts in programs that will come from it really lead the way and serve as an example for the national effort to follow.

So over the next 18 months or so, the national effort will be engaging stakeholders are both the regional and national levels to identify needs and areas for R&D investment to improve energy and water efficiency and energy and water availability.

And we think that the CEC, given the experience and insights they've gained, can play a very important role in this national effort. And CEC Staff have been involved already in the desalination roadmap that will be integrated with the energy/water nexus roadmapping activities.

And we hope that staff will also be able to participate in those complementary national energy/water nexus roadmapping and reporting activities, as well.

So, thank you.

PRESIDING MEMBER GEESMAN: And you see that culminating a report in 18 months?

DR. BURTON: There will be a roadmap in about 18 months. And in addition, a report to Congress; and that deadline is somewhat flexible at this point.

PRESIDING MEMBER GEESMAN: Okay.

DR. BURTON: But approximately 18 months at this point in time.

PRESIDING MEMBER GEESMAN: Well, I will make certain that we do make a significant contribution there. I think it's an important thing to participate in.

DR. BURTON: Thank you.

PRESIDING MEMBER GEESMAN: Thank you very much.

MR. TRASK: I'd also like to add my thanks to Liz. She also put in many hours over a weekend reading the paper and caught many, many, many embarrassing errors. Probably shouldn't even mention that.

(Laughter.)

MR. TRASK: The last speaker from our working group is Thomas Crooks. He's the Associate Director of Navigant Consulting, and is the author of appendix D. And he will be continuing the works of appendix D, which is our avoided cost based analysis of water conservation and efficiency programs.

MR. CROOKS: Thank you, Matt. It's a pleasure to be here today to address the Commission. I want to talk very briefly, just raise some points to have on the record with regard to item 4 and the importance of integrated water and energy planning.

Just to recap, we talk about the five steps for the water system savings for source, conveyance, treatment, end use, wastewater treatment and disposal.

In the past energy efficiency has been willing and able to incent and recognize the energy savings only associated with water heating or water pumping, or some end-use device that is an energy-consuming device.

With regard to Mary Ann Dickinson's previous reference to the partnerships of the early '90s where the utilities, both water and energy, collaborated, again we have just recognition of the water heating capacity of these devices. And there's no inclusion whatsoever on the table for these cold water savings for source, conveyance, treatment, wastewater treatment and disposal.

You know, such things as spray valves, very effective and wonderful program. Faucet aerators, showerheads, high-efficiency clothes washing machines, all these areas where the electricity utilities and the gas utilities and water agencies, you know, combine and collaborate on these efforts.

Again, the utilities only provide and count energy associated with water heating as that being saved. I'd submit that they're missing a large part of the energy savings associated with water conservation measures.

Even with the drip water systems today we heard that there's a bit of a problem, or a conflict wherein the drip water system may save energy -- or I mean, water, excuse me, but may increase energy. But is that from the whole perspective, from the five-component perspective?

I think that has not been addressed.

So, this is kind of a consistent theme that runs throughout the treatment of energy efficiency and water efficiency programs.

When the five energy associated with all five components and steps in the water system are considered, many conservation measures, or water conservation measures that might not be cost effective would be cost effective.

So, I think it's, you know, one of the key findings of appendix D, and I think one of the areas that need to be advanced and supported, is the fact that these cold water savings are important; they're large; and they're not currently considered in the cost effectiveness planning of energy efficiency.

To that end, I believe that the policy needs to be developed. The CEC really needs to take a leadership role in advancing policy that enables and insures that the PUC approve provisions whereby its jurisdictional energy utilities can count these cold water savings toward their very aggressive energy savings goals.

And at the same time, under such provisions, insure that ratepayer investment in energy demand side resources is made based on resource value, complete resource value.

Currently projects that would render cold water savings are not eligible for EE program incentives. We listened to representatives from one energy utility, PG&E, a program planner and cost effectiveness, stand up in these workshops and tell us that until the Commission told them that they could count these savings, they would not count them.

So this is a clear area where policy needs to be set and a leadership role is required, or called for on the part of the Commission.

I think to accomplish an integrated water/energy efficiency planning is as important in the loading order as it is, this is a requirement and won't go another step further, from the energy utility's perspective, until the PUC jurisdictional energy utilities can acknowledge these cold water savings, and must evaluate them along with the other resource alternatives.

PRESIDING MEMBER GEESMAN: Tom, let me ask you, there are some municipal utilities that provide both electricity service and water service. Have any of them developed an integrated methodology in evaluating cross-benefits from efficiency programs?

MR. CROOKS: I can't speak with knowledge of the public utilities. You know, anecdotally I understand there's great separation between the two areas. At the same time I also hear that various folks and SMUD, LADWP, are doing some integrated planning.

I'm limited somewhat. I'm an energy planner from the investor-owned utility regime. And so, you know, if we can affect 75 percent of the constituency that have, the last 30 to 35 years, led the field in energy efficiency, that this is the next area of growth, you know. And I'm sorry that I can't address your question better.

PRESIDING MEMBER GEESMAN: Thank you.

MR. KLEIN: Tom, may I ask a quick question. Where do you think, if you were to account for the water savings in the way you're describing, how far up the chain of decisions, in terms of rank order, would the cold water savings programs look compared to all the other energy programs that we're doing now?

MR. CROOKS: Those that we've looked at, and we tried to take it site specific so we really get down in the granularity and look at the water intensity for a given region. We'll need to develop, or there needs to be developed, moving forward, a cost/benefit bases based on water planning regions. The six or seven major water planning regions in the state would have different bases.

But what I've seen as far as the bang for the buck, or cost effectiveness of cold water saving measures in energy, they rank very high, in the 2 to 3 to 1 TRC, total resource cost test ratios. So they're very high.

And I think that, you know, I don't think they're getting their just due when it comes to evaluation against other energy saving alternatives.

MR. KLEIN: Thank you.

MR. TRASK: Thanks, Tom. Just want to add a little bit here about schedule. We have two more speakers scheduled, and then we have the presentation by the PIER folks. Then the Center for Irrigation Technology folks are also here for their demonstration out front. And the added benefit there is they are also providing us with lunch. So we can sit there and each lunch while they give us the presentation, which I thought was pretty nice of them.

Our next speaker is Steve Kasower with the U.S. Bureau of Reclamation.

MR. KASOWER: Thank you. My name is Steve Kasower; I'm with the United States Bureau of Reclamation. I want to thank the Commissioners and staff for undertaking this very important investigation into the water and energy nexus.

I was invited here by Dr. Chaudhry of your staff to discuss our perspectives on desalination and new water supplies and our relationship with the California Energy Commission Staff and the California Department of Water Resources.

I represent the organization at the Bureau of Reclamation known as the water treatment engineering and research group in Denver, Colorado. You may be familiar with our regional offices, the mid-Pacific region of the Bureau of Reclamation operates here in northern California and operates the Central Valley Project and other projects.

The Arvin-Edison representative, when he commented on the Bureau, was really commenting on that regional office and their activities.

In southern California the lower Colorado region operates the Hoover Dam and those project complexes. And has in it contractors, including the Metropolitan Water District of Southern California.

My organization is focused predominately on new water supplies and the technologies that are required to bring those new water supplies to the west.

A little history without boring you. In the 20th century my agency developed dams and reservoirs with a mission to bring water supplies to the west, including the 17 western states. We're standing here in the 21st century; all those dam sites, reasonable dam sites have been used up. We now know that there are environmental issues associated with those types of projects. We've come to recognize fish, we've come to recognize Native Americans, we've come to recognize communities and their perspectives.

And so the new water supplies of the 21st century are really focused upon impaired water. And you heard about that already this morning.

I'm not going to go through a litany of those water supplies, other than to remind you that they are the unused, unwanted water supplies, either the brackish groundwater; the wastewater from our municipalities, which here in California are increasingly used and called recycled waters; polluted groundwaters; stormwater runoff.

For my organization we're comprised of chemical engineers, civil engineers, political scientists and economists. In this case it's a pretty interesting working relationship.

I'm tasked as the desalination planning manager to take our research agenda and bring it into the planning world. And demonstrate it in terms of real world ability to make a difference in our water supplies.

So we are looking at an array of treatment technologies; we're concerned about concentrate management. What are we going to do with the brines and concentrates. This is another issue that we feel is of major import in the 21st century.

And we are the authors, with some

national labs, of the desalination roadmap. We worked with your staff on that. And that's a research roadmap that allows us to identify in real time the research agenda that we're going to need to bring that water supply to the growing west.

I want to leave you with two comments. One, I didn't do the in-depth review. Last week I reviewed the document and I was very impressed with the summary of California water and energy. And as I pointed out in my opening, I represent an interest in water supply in the west. So we work with the 17 western states, including California.

So I would say by no means are we California experts in line with the level of expertise that you've heard from today. But we have embarked on a working relationship, from a research perspective, with your staff and the California Department of Water Resources.

And we presently have a number of pilot project studies that are ongoing in California that your staff participate on, including our work in the Salton Sea with our vertical tube evaporator systems.

My final comment is just simply to thank you for allowing us to continue to work with your staff to identify the relevant research topics that we can fund or we can collaborate in funding that will allow us to bring new water supplies to the west. And indeed, develop those water supplies in the most environmentally and socially conscious fashion that we can, including the integrated view to energy and water supplies together.

Thank you.

PRESIDING MEMBER GEESMAN: Thanks very much for being here and for the close relationship that our staff has enjoyed with you.

MR. KASOWER: You're welcome.

MR. TRASK: Thanks, Steve. Speaking of desalination, one figure that we did miss by an order of magnitude in the report is we had reported that there was 4600 acrefeet per year of salt water, desalinated salt water produced in California. It's actually 46,000.

I also wanted to recognize again Monica Rudman in the back there as the contributing author who did author all the sections on desalination.

Our last speaker is Marshall Hunt with

the Yolo Energy Efficiency Project.

MR. HUNT: Thank you very much. My name's Marshall Hunt and I run the local energy efficiency program for the County of Yolo. And in that County the municipal water districts all have their own water system. And we are trying to integrate energy with their programs.

And I certainly look forward to more tools and resources to help us in this process, because it is a tough one to make contact at the local level.

But mostly I want to say I strongly support Mr. Crooks' analysis of what needs to be done as part of the ongoing energy efficiency program debate, that I'm very pleased to say that Mike Messenger has been an excellent representative from the Commission. And we now have an ad hoc professional advisory group, which he and Gary Klein are involved in. Thank you very much.

And we really want to look at hot water as a triple winner. Because when you have hot water distribution issues, when you have hot water efficiency issues, when you have hot water, both commercially and domestically, it's a huge impact.

And as we know, the natural gas consumption gets more and more related to electricity savings.

So, the one thing I would ask, as part of your assuming this leadership role Mr. Crooks so well spoke of, would be to add into the report some of the natural gas/hot water benefits.

And I'm reminded that back in the mid '90s there was an excellent workshop held here by the Commission and Commission Staff. And again there's great resources for that effort.

Thank you.

PRESIDING MEMBER GEESMAN: Thank you very much, Marshall.

MR. TRASK: Very good. Do we have any other parties who would like to speak or anybody on the teleconference who would like to speak?

Very good. Now we have scheduled a short presentation by Joe O'Hagan and Paul Roggensack of the PIER program. And it'll take us just a second to set that up.

PRESIDING MEMBER GEESMAN: Why don't we take a five-minute break.

MR. TRASK: Very good.

(Brief recess.)

MR. TRASK: Next is Kenneth Broome, who's been actively participating with us concerning water system energy production and primarily in pump storage.

MR. BROOME: Thank you, Matt. Good morning. I would like to also endorse what Lon House was saying this morning about the potential for small hydro. I've spent quite a bit of my professional career in recent years trying to get around the problems of small scale hydro. And the big problem is interconnection. And whatever you can do to simplify that process, make it more acceptable.

But the main thing I wanted to say, I was very pleased at one of the workshops the Department of Water Resources and the State Water Plan people gave a very full presentation of the pump storage potential at Oroville and San Luis. And it was just, as far as I'm concerned, unfortunate at the end where they stated what their mission is, that there was no mention of energy in it.

And even the second concluding statement they made is power production is the byproduct of water operation, and merely enables DWR to meet

SWP contractual requirements for water deliveries.

And I feel that if the DWR and State Water Plan would be more proactive in really helping the state solve its energy problems it would be beneficial.

Thank you.

PRESIDING MEMBER GEESMAN: While you're here, let me ask you -- sir?

MR. BROOME: Oh, I'm sorry.

PRESIDING MEMBER GEESMAN: The statement in the report, I'm afraid I don't have the page reference, that the existing pumped hydro system is optimally operated at present. Do you have a viewpoint on that one way or the other?

MR. BROOME: Which facility was that?

PRESIDING MEMBER GEESMAN: The existing installed pump storage.

MR. TRASK: That was primarily referring to the State Water Project pump storage with that.

PRESIDING MEMBER GEESMAN: It currently is operated in an optimum fashion.

MR. BROOME: I think it's optimal within the restrictions that they have to observe. However, --

PRESIDING MEMBER GEESMAN: Deliveries to

their contractors.

MR. BROOME: Yeah, deliveries and environmental conditions, low reservoir levels and temperature of delivery of water back into the river and that kind of stuff.

However, the reservoirs, themselves, have great potential for additional capacity. But it might need the investment of money in new equipment and pipelines.

But the basic reservoir and switchyards and transmission lines are probably adequate. It would be possible to augment the capacity of both the Oroville and San Luis complexes that wouldn't have to be part of a State Water Plan system. It could be a contract arrangement with municipal or private developers. So I'm offering that as a suggestion.

Thank you.

PRESIDING MEMBER GEESMAN: Do you have a viewpoint as to potential expansion opportunities or changes in operational practices of the Castaic pump storage facility?

MR. BROOME: I think it would bear looking at. In other words, again it comes back to what the objective of the organization is. And if the conditions are such, I think if a private contractor were operating those facilities I think they'd find a way to make money out of potential capacity that's not being used.

So it's a very sort of matter of judgment; but it's also a matter of incentives.

PRESIDING MEMBER GEESMAN: Thank you very much.

MR. BROOME: You're welcome.

COMMISSIONER BOYD: I would just say that's kind of intriguing. Spent eight years of my life at the Department of Water Resources in an earlier juncture. And your point about the private sector is something, I'll bet you, that has not been thought of.

During when the electricity crisis occurred, the sky fell on us. We did have many discussions with DWR about optimizing the pump storage. And they pretty well proved that they had optimized it.

But I think you're right, it's within the context of operating the State Water Project as constrained by the water contracts and so on and so forth, so, intriguing thought, worthy of looking at more.

MR. TRASK: I just want to add that Ken was referring to a meeting we had with the State Water Project people. That was actually one of our water/energy relationship working group meetings. The transcript is available on our website. I think it's actually a very good read. I learned a tremendous amount that I was not aware of about the restrictions.

One thing that they did point out that I thought was very interesting was that they actually participate quite a bit in the ancillary services market. And are probably, in that sense, optimizing the state's investment in those facilities through that process.

Okay, next up is a presentation by Joe O'Hagan and Paul Roggensack from our PIER office about present water/energy research.

MR. O'HAGAN: Thank you, Matt. My name is Joe O'Hagan; I'm in the Public Interest Energy Research in the environmental research area. That's one of the six PIER research areas. There's two that address water issues. Paul Roggensack will follow me, and he's in the industrial and agricultural water area.

The mission for the environmental area

is to address the environmental effects of electricity generation, transmission and use. Certainly generation and use is of interest for this workshop. And our goal is to identify solutions to these environmental problems.

The major focus for the environmental area in regard to water resources so far has been focused on ways to reduce fresh water consumption by the electricity generating sector. And to minimize fresh water, potable water supplies that are being evaporated out through cooling towers. Looking for ways to reduce the impacts from electricity generation on aquatic species and habitats, specifically talking about the effects of hydropower operation and once-through cooling technology for thermal generation on aquatic species.

Also looking for ways to enhance hydropower generation with the existing infrastructure. As Matt has indicated, we don't anticipate much new large-scale hydropower generation within the state. But there are opportunities to enhance hydropower generation and water supplies from the existing facilities without additional environmental damage.

And then finally we're also looking for opportunities to provide analytical tools to water managers, either on a state, regional or local basis.

The major focus of the program, of course, has been looking at reducing fresh water consumption by the thermal generating sector. A lot of our efforts have dealt with air-cooled condensers, dry cooling, concerns about wind effects on these condensers, and also looking for opportunities to enhance the efficiency of these facilities during the hottest days of the year when there is a dropoff for these plants, once the ambient temperatures exceed the design point.

And, of course, in California here the concern is for peak electricity demand. We've done a number of projects. We've worked with different parties. We're going to have a demonstration of the spray enhancement this summer at the Big Horn air-cooled power plant. We're also doing several evaluations of different power plants on the wind effects of air-cooled condensers. And here are some of the participants we've worked with, as well as a number of others.

We're also looking in the future in

terms of other opportunities to reduce fresh water use. There's a number of different approaches that can be taken that we haven't yet addressed. Improvements to heat transfer, air-cooled condensers, just a big radiator, a better metallurgy, or tube-and-flange design may enhance heat radiation from the condenser.

We're also looking at ways to recycle water in power plants; capturing water from flue gas systems. So those are some of the things we're looking at in terms of the future.

To enhance hydropower generation, one of the best opportunities is to improve forecasting and decision management. We have a major demonstration project at four northern California reservoirs, three of which are shown in the picture there to the right. Folsom is the fourth. And this is to provide probablistic forecasts for runoff so that the reservoir manager will have a better idea of whether they need to spill water or to provide adequate storage for additional flood control, they can run water through the turbines, or they need to retain water for water supply.

And then also to help them adjudicate between the information that this project also demonstrating decision-support models to help them make informed decisions based on the information provided.

We're also looking at seasonal forecasts for hydropower, both in California and the Pacific Northwest, to allow better planning for the system, better planning for natural gas purchases when there is, as there is right now, a drought in the Pacific Northwest. Hydropower available on the spot market may be significantly reduced; that will require a more thermal generation, gas-fired generation and more natural gas supplies.

We've also, once again, worked with a number of parties, including the Bureau of Reclamation and DWR on these projects.

Then another effort we've had is trying to address the ecological effects of hydropower operation. One of the big concerns in California is the over 3000 megawatts of investor-owned or municipal-owned hydropower is going before FERC for a hydropower relicensing. One of the big concerns has been what I call ramping flows here, and other manufactured flows, where these rapid increases and decreases in discharge can really adversely affect species. And so we have a number of projects actually being conducted right now to address this issue.

Another issue that we would like to address in the near future is how you determine instream flows. Instream flows is how much water you want to allocate for a particular resource. In this case we're talking about fisheries and other aquatic species.

The way, as often the case, when biology meets engineering it's not pretty. The way things are determined is often a black box. We'd like to sponsor some research that would inform the way people can reach these decisions. And this is very important for water supply throughout the state. Because certainly in water-rights cases they use the same methodology that they use in hydropower. It's how much water can you divert; how much water is necessary to sustain a healthy aquatic ecosystem.

And we've been involved with a number of utilities, state and federal agencies in these research efforts. And I expect that to continue.

One of the things we're trying to get at is the previous discussion was sort of water for electricity. There's also the electricity for water side of the issue.

One effort we're doing, of course, is the effort by Bob Wilkinson and Gary Wolff that's come up with what we term the spaghetti chart, to somehow come up and depict the interaction of water and electricity throughout the state. Basically a flow chart that would show not only the gains from generation, but also the losses in terms of different uses.

We're also looking at the question of how much water is embedded in electricity. We certainly have been discussing today how much electricity certain water actions require. But if you're trying to balance out electricity conservation and water conservation there's going to be certain measures that require to conserve water or acquire more electricity.

Well, the question becomes how do you know what you're gaining. How much water is used to generate a kilowatt hour that is used here in California. And we don't know the answer to that. And that's one area where we're very interested.

We're also interested, as I said, in developing tools for water managers in the state, not only on a statewide or regional basis, but also on local. Electricity costs for many jurisdictions is high. And then many of them have an aging infrastructure. They need to address how they're going to meet their growing population; how they're going to replace this aging infrastructure. And so we're looking at tools that can facilitate that and let them identify the environmental and electricity costs, tradeoffs involved.

One project that we have that will be coming out -- a report will be coming out shortly is a life cycle assessment of alternative water supply systems in California. And this is a model that was developed by a professor at UC Berkeley. And he did a case study looking at two water districts in California, one in Marin County, one down in Orange County, I believe. And looked at the tradeoffs between -- from construction operation and maintenance efforts to looking at everything from greenhouse gas emissions, material waste and efforts like that. Very interesting report.

Like I say, that should be available shortly. And our hope is to enhance that model to make it even a more useful tool for people to evaluate the tradeoffs between different approaches to meeting sufficient water supply.

Thank you, and I'll turn this over to Paul.

MR. ROGGENSACK: Thanks, Joe. I'm Paul Roggensack; I'm a contract manager; I manage this contract we have with American Waterworks Association Research Foundation. I'm going to talk mainly about this one product the PIER industrial/agricultural water team produced two years ago.

We use this document to guide our research and development activities. Although this isn't our only source of R&D funding. We also fund projects such as for wastewater treatment through Southern California Edison and arsenic research with Lawrence Berkeley Lab. But this is a source of a lot of our R&D activities.

We came up with a roadmap in February 2003. The Commission, along with AWARF, invited roughly 40 industry experts from the water and wastewater industries. And we conducted a workshop at the Hilton on Arden Way here in Sacramento.

We asked the workshop participants to

identify the main research areas and issues that affected energy at water and wastewater treatment plants. And we also asked them to give us suggestions for R&D projects that we could actually fund along with AWARF.

These were our objectives of the roadmap here. We wanted, like I say, we wanted to identify R&D activities, and identify the issues that affect industry and provide specific projects.

These were the key issues that our workshop produced, identified on the roadmap. Water quality and supply is mentioned in there. Reliability and I'd also mention that the nexus between the water/energy link was also identified by our workshop two years ago.

And these are the eight primary research areas. Advanced treatment processes, desalination, energy generation recovery, societal and institutional issues, energy optimization, sustainability, decentralization and total energy management.

The workshop identified 44 potential research projects. And the participants ranked these according to the most pertinent. And we currently have contracts on these five projects right here. These were the five highest ranked ones.

They addressed -- one addressed desalination. And we're also trying to benchmark energy use for unit operations in the water/ wastewater industry. We're doing R&D on water consumption forecasting to improve energy efficiency of the pumping operations. And we're also coming up with other theoretical means of coming up with energy use for the operations.

Okay, I'm missing a couple slides here, but we had representatives from Water Environment Research Foundation. Also the attendees included the utilities public, Southern California Edison, Pacific Gas and Electric. And we also had Department of Water Resources attended. We had representatives from universities and the national labs, Lawrence Berkeley Lab and Sandia Labs. And we had about 15 representatives from water and wastewater utilities.

So we're continuing to work with AWARF and AWARF is a natural for us to partner with because their focus is on research for water utilities. So we've had a good relationship thus far, and we continue to do so.

MR. TRASK: Very good. Well, we're essentially coming up to lunch time here. I'm told that lunch is ready for us out at the demonstration truck. But Jim Tischer is, I believe, here somewhere. Oh, there he is. Jim. And we'd just like to actually show a couple of movies for you before you go out there.

MR. TISCHER: Thanks, Matt and Commissioners. I'm Jim Tischer; I'm the Regional Program Manager for the ag pump efficiency program. We're part of California State University at Fresno's Center for Irrigation Technology.

We're the statewide program managers in all four investor-owned utility areas to work with farmers and water districts, golf courses. And now, as of May 16th, we can work with urban water districts, urban water agencies and tertiary treating agencies, as well.

The program has four components. It has education, which you'll see outside when you go out with one of our two mobile educational centers. My colleague, Bill Green. We have technical assistance regionally. I, myself, am based in Woodland.

We have subsidized pump efficiency tests where we pay for the pump tester, one of our 42 pump testers to go out and work with a farmer or water district to generate the diagnostic. As you may or may not be aware, until we started this there had been no pump testing since deregulation in 1996. So there were some pretty sick pumps out there.

We also do cost sharing on pumps that need to be repaired, so that the farmers and water districts and others can realize the benefits much sooner.

To date, since we were commissioned by the Public Utilities Commission in October 2002, we've done almost 1.3 million in incentive rebates on pump repairs; we've saved about 17.5 million kilowatt hours and 360,000 therms of natural gas.

We've provided about 1.1 million in subsidies to perform over 6000 pump efficiency tests. And we have conducted over 80 educational seminars using the MEC that you'll see outside.

With that, we're going to roll about a three-minute CD that will explain the program graphically to you, visually. We encourage you to step outside for the accelerated executive briefing on lunch. We have lunch for you to attract you so that we can reinforce visually the water/energy connection.

And we applaud your effort and your staff effort in connecting the dots on the water/energy connection, and realizing the importance of the air component, as well. So, mega kudos.

MR. TRASK: I apologize that you're not going to be able to meet Gwen Stefani, and you're not going to get five free songs.

(Laughter.)

UNIDENTIFIED SPEAKER: That's for another day.

MR. TISCHER: This is the pump test video. If we were going to meet with farmers or water districts or golf course superintendents we'd go through the steps of a pump test and the diagnostic information that is evolved out of that.

What we're going to show you now is we're going to back up one level and give you an actual overview of the program.

(Video presentation.)

MR. TRASK: That's it. I want to thank everybody for coming this morning. Also everybody who's participated all throughout the process. I'm very pleased to hear that we will be producing a final version of the water/energy relationship study. And we'll get that up on our website as soon as we can.

And with that, I think we'll adjourn for lunch. And, Commissioners, what's your pleasure for recommencing on the hydro paper?

PRESIDING MEMBER GEESMAN: Why don't we come back at 1:30.

(Whereupon, at 11:57 a.m., the workshop was adjourned, to reconvene at 1:30 p.m., this same day.)

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AFTERNOON SESSION

1:38 p.m.

PRESIDING MEMBER GEESMAN: Okay, let's reconvene. Jim McKinney.

MR. McKINNEY: Hi, Commissioners, Advisors. I'm Jim McKinney, Project Manager with the systems assessment facilities siting division. And we're here today to present a paper on potential climate change effects on hydropower production in California and the western U.S.

This is a consultant report prepared primarily by Dr. Suzanne Phinney and Dr. Richard McCann, who will come up and make presentations after I do the introduction.

Guido Franco from our PIER program, who is quite involved with climate change research, also has a brief presentation to make after this.

So, thinking about why we decided to do this paper in the '03 Energy Report or Integrated Energy Policy Report, one of the items related to climate change was that it had the potential to affect a full range of environmental and kind of human services issues, one of which is hydropower production in California.

It's obviously a current policy area of

interest for the Schwarzenegger Administration. And, again, through PIER, we're sponsoring just a tremendous amount of work on hydropower -- or climate change issues.

So why are we doing this paper? Obviously hydro is a critical element in the state's resource mix. Excuse me, getting over a cold here.

But one thing that we realized is that a lot of the studies are very very broad and they're focusing on hydrology, weather, water supply issues. And some of the studies will have little bits on hydropower in bits and pieces. But I was at a presentation last year that Guido sponsored from the Scripps Institute, and the hydro presentation there focused on really the federal water project, which is a fairly low elevation. It's a big project, it's 6000 megawatts, but it's low elevation and really not representative of the state's hydropower system.

To our knowledge no other state or institution has really keyed in on, you know, hydropower production and the potential for effect from climate change.

This is also the first in I think what

will be a series of applied papers. So, again, PIER is sponsoring a lot of very important research. Our goal with this paper is to start taking some of their findings and applying it to a set of issues that we work on a daily basis, which is hydropower.

Most of the work that my group does on hydro tends to be the effects of hydro on the environment. And this is the flip side of that. It's an environmental effect on hydropower production.

So we have a number of purposes that we wanted to accomplish in this. So, again, the potential for changes in hydro production.

And the way we did that is we went through the literature. Guido Franco provided us with an extensive bibliography. And that is one of the things Suzanne Phinney did, was to really go through that and find out which ones are most applicable to the work that we want to do.

We identified key variables and issues. And then to the extent that the data allowed, Rich McCann did a quantitative assessment, which, again, is preliminary.

We also wanted to see how are the major

hydro producers and planning agencies in California and the western U.S. really thinking about climate change. Are they tracking it, are they incorporating it into long-term planning. Has anybody actually factored it into operations yet. So, again, Suzanne will present on that one.

A couple of disclaimers here. One thing this report will not do is say we know that by the year 2061 we're going to have an x percent reduction or increase in hydropower production. Actually we're doing this paper to get away from that type of predictions that I've seen in a few headlines in various newspapers.

So, again, we're really trying to do what we do well here at the staff, which is systematically think through a set of very complicated issues and apply some rigor, build on the existing research, and move it a step forward and set the stage for some other folks.

I spoke with an official from PG&E a couple weeks ago, and he said this is all really interesting and are you going to talk about how are these potential ranges and changes in hydropower production from climate change going to vary from the existing range of production that we already have. As you all know, there's no such thing as an average water year in California. It's a dotted line on a graph. So that's one thing we hope to get out, as well.

The way the paper is set up I'll essentially talk about baseline conditions, which is the hydro infrastructure and production levels here in California, the northwest and Colorado.

Suzanne is going to talk about the climate change studies we reviewed and used for this report; and also the scenarios that we gave to Rich.

He's going to present the, you know, the smart-guy part of the presentation, so a lot of good analysis in there.

And then we'll come back around to Suzanne to talk about the results of her survey with producers and planning agencies on the west coast.

Another thing that I thought might be an interesting question was since we're talking about changes in the storm frequencies, storm events, rises in sea level, what's the potential for effect on coastal power plants. We have 21 of them; they're about 23,000, 24,000 megawatts.

It's a big part of our system in California. So we wanted to see what was the potential for adverse effect there, as well.

So for the three areas that we studied, you can see the numbers for yourself. California, the northwest and the Colorado River. On a average annual basis we get about 15 percent of our energy from our instate hydro system. That works out to 37,000 gigawatt hours. But there's a huge range, and again that just varies by water year type.

One of the things that we though was really important to distinguish is between energy out of the hydro system and peaking reserve capacity. And that's really where hydro shines as an energy resource; it's ability to quickly ramp up and down and provide both load-following and peak energy on those peak demand days in the summer.

MS. JONES: Jim, can I ask you a question just to clarify. You have an average of 15 percent of energy supplies. Over what period of time?

MR. McKINNEY: This was from, I believe it was '83 to '91.

MS. JONES: Great. Thank you.

MR. McKINNEY: We tried to get a long-term average there for you.

You can see the northwest has a lot more megawatts and a lot more production. And our summer imports range from 4000 to 7000 megawatts. The Colorado River is a smaller system, but on our supply demand balance tables there's the all-important Hoover entitlement line, which works out to a bit over this figure here of 6, 26 megawatts.

For resource adequacy, which is -- let me explain how we think about this stuff -- resource adequacy is at the state level are there sufficient energy resources to make sure that we're going to have available supplies to meet all peak demand scenarios. And that's a statewide scenario. If we break that down into regions, the ISO will break it into control areas. But we tend not to go to the firm level.

But one of the things that Rich will talk about later is that the potential for effect will vary depending on who actually owns the hydro facilities in their utility district.

So, again, we're going to focus on peaking reserves as an important part of this.

I'll give you a little bit of history about the infrastructure, energy infrastructure here in California. So hydropower was really the basis for the 20th century infrastructure. So you can see there on the left -- use my pointer here -- so down here hydro was really a critical part. And it's most of the energy and capacity in the state.

So even through World War II it was more than half of what we've got, you know, had at that time. We saw more additions for hydro in the '50s and '60s, and the last big spurt was late '70s, early '80s.

This is going to be a fixed proportion. As demand grows, as our generation capacity grows in the state, these numbers will get quite a bit bigger.

So it's an important part of our resource mix, but it's also a very variable part of the mix. So I talked before about the range, 9 to 30 percent in energy terms. But in terms of summer, when we talk about dependable capacity or the derate of hydropower, it drops down to 8500 megawatts. But that means 8500 megawatts of firm capacity available for six hours at a continuous stretch on a given summer day. So that's quite a big number.

Something else with hydro is that it tends to peak during the spring, during the high runoff season. And that's not peak demand for us. That's a low demand period. Our demand peaks a couple months later.

As I showed in that last slide, it's a fixed resource at this point in time. Really, you know, all of the economically viable sites have been built out by the utilities. And we're seeing that it's the gas-fired part of the fleet. So the boilers, combined cycles and the new single cycle turbines, the peakers, that are going to provide more and more of our energy mix.

So I put this up here. This is something from our electricity analysis office. I think when most people think about hydro they think hydro does this for us in the summertime, that it's really a huge contribution to meeting again state demands. It's actually a must more modest part. And you can see, that's carried by the gas part of the fleet.

This chart looks at it a slightly different way. Average capacity factors are, you know, how many hours out of the year did a plant run. So 100 percent means it runs 8780 hours a year. And then you can just work down from that.

So, the nuclear plants up here. What are we calling these -- excuse me -- must take, so these are biomass, cogen, waste-to-energy, that type of thing. The blue line is large and small hydro and wind. And what you can see here is the peak production occurs, again, a little bit before where we are now. So it tends to be April/May, during high runoff, whereas the gas-fired part of the fleet, which is doing the load following and peak demand, really ramps up in the summertime.

I want to introduce some of the issue on variables to kind of keep in mind as we go through the presentation today. So, one of these is that ownership and project purpose, in other words why was the hydro facility built; how was it built; how does it meet the needs of the generally utility that built it. That has a lot to do with how we're going to think about potential effects.

Type of hydro project is obviously important. We have three main types in California. The pump storage, so it's Helms and the Castaic on the LADWP system. The dispatchable hydro which is a classic, you know, reservoir penned stock, high head system here in California. And then run-of-river, which, as it implies, you produce electricity as water is available to flow down the rivers.

Elevation. When you're talking about climate change effects elevation of the reservoirs and power houses is one of the most important variables. The ratio of snow to rain is also a very important variable. Changes in the freezing line, that is at what elevation do we get freezing and not freezing. So again, that affects snow.

The ratio on reservoir capacity to total unimpaired runoff by watershed. Again, this is going to vary for every watershed in the state.

One of the things that we think you're going to see is there may or may not be absolute changes in production up or down. But there would certainly be shifts in production. And, again, because of the way California's demand and load works, because of the way the current system is configured to take advantage of the snow melt and work to meet peak demand, that's something important to keep in mind.

And as I alluded to earlier, the changes that we see are going to vary by watershed and by this configuration of reservoirs and power houses and penned stocks. Again, that ratio, how big is the reservoir compared to the total snow pack in a given watershed. And that's going to vary by utility, so it will vary by the CVP or SMUD or Turlock Irrigation, et cetera.

So this is just a brief summary of who owns what here in the state. So the IOUs own what's, I kind of call it a classic system. So smaller reservoirs, high elevation, high head, that means a large distance differential between the top of the penned stock and the bottom. So you tend to get a lot of power for not that much water.

The big federal and state water projects. Something we've learned with some of our other work is that the power preference customers who enjoy very cheap federal power, as production changes in the federal system, those are the folks that lose out.

So the Central Valley Project exports a lot of its electricity for retail sales. The State Water Project is an importer, as we've learned, for energy purposes. And then you can see the breakout there as we go down.

So, again, the munis tend to be focused on power and water supply. Water and irrigation districts are going to be more water supply. But, again, there's this mix of services available within a given hydro system that include water supply, power generation, flood control. And the way those three, I'd say parameters of a different system work are interesting to look at, the different scenarios.

MS. JONES: When you talk about capacity, is that the nameplate capacity, or is that derated capacity?

MR. McKINNEY: No, I tend to use nameplate capacity.

So, again, say it a slightly different way. So use is a function of elevation, so again primarily higher up in the Sierra Nevada Cascade watersheds you have the IOUs -- in the foothills you've got the public utility districts and the IOUs; and on the Valley floors you tend to have the bigger state and federal projects, and a lot more of the flood control going on.

So, you know, this system has been built up over 100 years based on the hydrology that's typified the west over the last several hundred years. It's really built to strategically and efficiently capture the existing snow melt timing and patterns. And it's those patterns that we anticipate changing in the future.

And I think what this last bullet point refers to is that for a lot of the public utility districts the hydro element in their resource mix makes up a larger proportion of their ability to meet customer load than say it does for PG&E or Edison or some of the other big load-serving entities.

And so switch to say a watershed scale analysis. These are the main rivers. You can see the relationship between the nameplate capacity and annual average production.

I'm not sure I can pull this off. I'll try to walk you through the main watersheds. Up here is Shasta; you've got the Pitt River coming in and the big CVP facilities around there.

Coming down here you have Lake Almanor, the Feather River system, really big -- yeah, 1600 megawatts total between PG&E and DWR's Oroville facility.

Moving down here you have the Bear Yuba

system. Here's SMUD's American River system. And further down we have the Mokelumne/Tuolomne, et cetera.

Southern California, so here's the Owens Valley LADWP system. I think that's the Kings River where PG&E's got its big Helms pump storage facility.

And then down here in the Los Angeles mountains, these tend to be much smaller in scale projects with not a lot of storage.

And with that I'm going to turn it over to Ms. Phinney.

DR. PHINNEY: Thanks, Jim. This part deals with the climate change studies that are out there. What we tried to do was focus on those studies that looked at the hydrologic parameters that would be important for hydropower production, and also those studies that are very limited in nature that identified changes in actual hydropower production.

There are a large number of studies and particularly specific to California. The ones that we used were primarily sponsored by PIER and provided a lot of information for our use. Most of these studies use general circulation model to depict the changes. There are a large number of models, and they're continuing to evolve. So one type of model that you use this year may have a new and improved version in the following year.

And also most studies use the extreme ends of the scenario spectrum in order to bracket effects. If you were to look at all of the models you'd have a range of effects from the very most severe climate to less severe climate. And so since no one knows which one is really the most appropriate, they try to use the ones at either end to show how the effects may change.

It's very difficult to compare the climate change studies that are out there for a number of reasons. There are greenhouse gas emission scenarios will vary. They use different global climate change models. The scale of the model may be different. It may be global, summer now at the regional level, and although very few would be at the local level.

The purposes of the study vary. Sometimes they're designed to just look at the hydrologic parameters; sometimes to look at how water supply may change.

Time periods differ and the geographic

areas of study will differ.

Despite all those caveats, there are certain trends that become obvious when you look at all of the studies in conjunction with each other. One is that precipitation varies widely and no one knows whether it's going to be wetter or drier into the future. And there's, again, no clear relationship between precipitation and temperature.

There is a current warming trend that the literature points out to, and also my discussions with hydropower operators. They have been observing that. And this continuation of the current warming trend will produce an increased rain-to-snow ratio. It will delay the onset of the snowfall season, and shorten that season; accelerate the rate of spring snow melt; yield a more rapid and earlier runoff in the spring months and much less runoff in the summer.

And as Jim pointed out, these changes are less significant at higher elevations. If you're already at levels where above freezing and the temperature rises a few degrees, it's less likely to make a difference. You'll still be at freezing.

In addition to the studies that are out there, PG&E has put out a few articles that reflect their observations in hydrologic parameters. And they have seen a 50 percent decline in snow-melt induced runoff, and a decreasing trend in low elevation snow pack, meaning that the snow level is increasing.

In terms of there are two major systems, the Pitt/McCloud and Feather River, which actually supply about 55 percent of their hydropower, slightly different results there. The Pitt/McCloud Rivers, they are lower elevations, so they should be affected more. But they're less reliant on actual runoff because they get aquifer outflow from the poor soils in the area.

The Feather River, on the other hand, is more reliant on snow melt. And it's an important peaking summer resource for PG&E. They have observed that actually the high runoff that could result in the spring could actually cause the system shutdown because they would try to divert that water to avoid damaging their hydropower facilities.

And then that also kind of leads to the point about how, not only from a damage standpoint, but as that water progresses down a lot of it may be diverted to allow reservoirs to keep capacity for later flows. And I think there'll be further discussion of that.

And then finally, they haven't made any changes to their system. They feel that it's a design for a large wetness variance. And actually we've seen that in a fair number of conversations that people feel that their system is design to handle California's current variances. And whether it will handle it in the future is probably yet to be seen.

PRESIDING MEMBER GEESMAN: Has PG&E shut down the Feather River system before?

DR. PHINNEY: I don't know that answer. This slide now looks at actual studies, or studies that looked at actual changes in hydropower production. There's been an extensive PIER study that used the Calvin model. That actually should be capitalized, Calvin. It stands for certain things which I have immediately forgotten, so can't tell you. But it's not Calvin and Hobbes.

And that --

DR. McCANN: (inaudible).

DR. PHINNEY: Pardon me?

DR. McCANN: -- got that in part from Calvin and Hobbes.

DR. PHINNEY: Oh, really? So there's a history to it? I'll let you talk about that, Richard.

(Laughter.)

DR. PHINNEY: But they identified that hydropower would decrease under a dry global climate change model. And under a wetter climate change model it would increase in winter, but decrease in summer.

There was one study specific to the Sacramento/San Joaquin area that used the dry climate change model. And it showed a decline in hydropower production up to 11 percent.

I'm going to come back to this study when I talk about the Pacific Northwest and the Colorado River Basin, because there were three sets of researchers that used the same methodology. So while you're not typically able to compare, you can kind of make gross comparisons when they use the same assumptions.

And what these changes show is that the hydropower production is not in synch with demand changes. That you're seeing a decreased demand in winter when you actually will have increased production; but an increased demand in summer, of course, warmer temperatures will increase the demand for electricity. And that's when particularly it's going to be falling off.

Looking to the Pacific Northwest and the Columbia River Basin, those climate change studies show pretty much the same, almost the exact same changes in the hydrologic parameters. Using the dry GCM, global climate change model, similar to the one that was for the Sacramento/San Joaquin area, hydropower production would drop less than 10 percent.

What was interesting was their summer surplus capacity may fall, which would mean less power available to California. And the Pacific Northwest would be competing with the southwest for replacement water. That study concluded in some of the planning studies that they may need to, the Pacific Northwest may need to plan for both winter and summer peaks.

And then looking at the Colorado River Basin, again this study showed the same changes in hydrologic parameters. And using that dry global climate change model that actually shows snow pack decreases 30 percent, runoff decreases by 15 percent, which will have major effects on the ability to provide water to all of the users of the Colorado system. But most interestingly that the hydropower production would decline by 50 percent. So a much greater effect to the Colorado River Basin.

And all of these studies were kind of reviewed and used. And a select number were used by Richard to do his further analysis. So I'm going to turn it over to you.

DR. McCANN: Good afternoon. I'm Richard McCann with M.Cubed. What I'm going to talk about is an analysis that we did looking at some bounding cases for potential changes in runoff and implications about hydropower production in the State of California.

So what we looked at was a range of climate scenarios. Suzanne had gone through and identified some scenarios talking with PIER. We identified runoff scenarios that were used in the Calvin model by UCDavis. And we took a couple of bounding cases out of that analysis in order to pick a very wet year and a very -- or a very wet scenario, I should say, and a very dry scenario in terms of potential outcomes associated with potential climate change.

And one of the things I want to really emphasize in this is that when we were doing this we were looking at the range of possibilities. These aren't forecasts. No one should be going out and saying, well, hydropower production is going to increase 75 percent or it's going to decrease 25 percent, because you can't say that from these scenarios. We simply don't have that kind of information.

But it does tell us what the potential outcomes are and what sort of preparations we may want to make in terms of accommodating those kinds of changes in the future. And I'll talk a little bit more about that as we get to our findings.

Another important thing to understand is no probabilities can be associated with these forecasts. So that's one of the reasons why we can't make a prediction about how things are going to come out.

Just to summarize the two scenarios, the wet scenario is from the Hadley climate change model number two. And in that case the total California runoff increases about 76 percent on average.

The second scenario, the dry scenario, is from the PCM model. And in that case runoff decreases by about 25 percent. What's interesting is that 25 percent decrease is putting you down somewhere in the not critically dry, but in the dry range for what currently occurs in California's water system.

PRESIDING MEMBER GEESMAN: Just to set a context, what vintage were these models?

DR. McCANN: Vintage in --

PRESIDING MEMBER GEESMAN: Well, Suzanne had mentioned that the models are rapidly evolving. When these two scenarios were created what vintage of model --

DR. McCANN: I believe they're 2003. Guido can actually probably tell you more about that. The studies were done in 2003. I understand there's, in fact, another set of model runs that are available.

But one of the things is not to attach too much to the model vintages, per se, except for to look at how much they might vary from case to case. The most important thing is to understand this is how much the range could actually occur in the future, looking at this analytically.

And I don't expect that those bounding cases will change a lot, maybe 10 percent one way or the other, in the future. But it's informative to look at these.

The value of looking at the scenario range, just to tick off some important things about it. One is to use the results to choose among different resource planning options, so that you can use some of this, even using financial planning tools to look at your options values, to determine what sort of resources you may want to choose. And what are the types of strategies that you have which may cost you least if things change in the future differently than the way that you anticipate.

So, looking at this range of variability is important in doing that, rather than looking at single-point forecasts.

The second thing is that to reexamine our priorities and coordinate policies on flood control, hydropower, water supply, recreation and environmental protection. And what we find in looking at these is that you have these new tradeoffs between flood control, between hydropower production, between water storage. And it's going to change the institutional dynamics of the state and how the state manages these resources.

And understanding how these might change will allow you to look at how to change the rules under which all of these various resources are managed.

The other thing is focus on future studies, which is to look at how the runoff timing in variation changes with elevation, with the scenario, and be able to illustrate this a little bit more. You'll see that the system is designed for one type of pattern of runoff. Well, if it changes a lot, that's going to have some implications for how you have to change the rest of your system.

There's some additional factors that affect hydropower. And I want to just go down the list here. These are things to keep in mind while I'm talking about the outcomes and the results of the analysis that we did.

The generation capacity of the hydropower plants are obviously important to the grid, and that's one dimension of hydropower that we're looking at.

The second is reservoir size. And the size of the reservoir, what it gives you is the ability to shift natural flows to times where you want to use that water for hydropower generation or for water supply. Or to use that space t prevent floods. And so the reservoir size is an important component of that.

Related to that is the size of the flow, the river flow to the reservoir size. So you may have a very large reservoir, but if your river has an even bigger flow, that may help you less than having a smaller reservoir that is very big relative to the flow on that river. So, it's got sort of a complicated way of saying that flow and reservoir size matter to each other. And that really affects your ability to manage those flows.

And then the last thing to consider is the elevation level of the power houses and the reservoirs that you're looking at. And this has to do with how quickly the runoff comes off the snowline, off the snow pack during the spring. And affects your ability to store the water and to use it for generation at the times that you want to use it.

So that if you have all of your snow -- for example, if all of your snow is gone at the end of March you're going to have a lot of problems meeting demand in August. That was one of the things that actually -- in 1997 we had a very large snow pack, and then all of a sudden it got very warm in April and all the snow was gone by the end of April. There was actually some concern about hydropower shortage when we got to August because of that factor.

So, the implications of changed runoff for hydropower, just to reemphasize again, is that the snow pack is really a large reservoir. It's -- we didn't build it; it happens to be there naturally. But that reservoir is something that we count on in order to get generation, to get water to our generating capacity. And we've built our system -- and I'll point it out in a graphic a little further on -- of how we built the system to basically use that snow pack in order to run our hydropower system.

And what happens is if you have a decreased snow pack that means that your reservoir has actually decreased or is less usable during the summer. And that makes it more difficult to use your hydropower capacity when you need it at peak demands.

Also, increased winter flows that are associated with accelerated runoff can increase your flood control requirements. Well, what happens is you have to clear out reservoir space in order to create flood control space. That means that you're decreasing the probability of having water stored going into the summer. And so that can further degrade your ability to generate power during the summertime.

And the last point is that reservoir capacity, and I'll illustrate this in a slide here, that most of the reservoir capacity that we have that's built reservoir capacity is well below our generating capacity on the mountainside.

That means that most of the reservoir capacity is below 1000 feet; between 1000 feet and sea level. And most of our generating capacity is actually spread up the mountain, up 4000, 5000, 6000 feet up. And so most of that generating capacity is actually using water that is running down in the stream that was previously stored in the snow pack.

So what we did in terms of our analytic

approach is that we developed these runoff scenarios, and we segmented them by river basin, major river basin. We were not able to segment them by elevation yet. That's one of the tasks that probably should be undertaken in the future so that we can look at these variations related to changes in the runoff from the snow pack.

And then what we did is we identified what river basins are the ones that are going to be most affected by potential changes in runoff scenarios.

So what we did is we have, here's the two scenarios -- or three scenarios. This black line here is our historic average. And that is an average over a period of 1920 to 1993. You can see that it starts low in the winter, in the late fall; increases up in Mach and April; and then hits its peak in May and June as the snow melts off. And then drops off very quickly to August and September.

Now, what the wet scenario has is a very large increases, actually the flows are slightly higher in the late fall, but then jump dramatically in January and February and March. And then drop off. And then what's most interesting is that even in the wet scenario the runoff is about the same over this time period, over the late summer, early fall. And so what we're experiencing is a very large increase in wintertime flows under this scenario.

The dry scenario has very low flows in the late fall, and then an increase. What happens is that the runoff is delayed. That is, that it moves up more slowly in the wintertime, and then peaks. And in fact, even goes higher in February than what the historic average has been.

So, in fact, what we're seeing is it's all coming down the mountain at once. Because then it's very high for a couple of months and then drops off very quickly. And so what we're losing here in this space is runoff that is used for summertime hydropower generation. We wouldn't have that. And the fact is that because this runoff is so high in this time period we'll actually have the same flood control requirements. We'll still have to maintain the same flood control rules under this type of scenario, but we won't have the storage, remaining storage to meet summertime peak loads --

MR. KLEIN: Quick question, Richard?

DR. McCANN: Yes.

MR. KLEIN: Following the flood control issue in the wet scenario, would you describe what the implications are on that?

DR. McCANN: Well, under this scenario, this scenario will overwhelm our current flood control regime. That is that we will basically -- we may have to get to the point of emptying the reservoirs in December in anticipation of this period. And basically holding the reservoirs empty until we get out here into April and May. And then at that point trying to capture runoff in April and May for the coming summer.

The problem is that you still have dry years in the wet scenario. And the dry years are actually not much wetter than the dry years that we have now. So that in fact what you can do is you can mis-estimate what the winter is going to be like, leave all of this space and then have no runoff in April and June. And then have very empty reservoirs when you get into the summer peaking period. Basically lose all of your hydropower generation entirely.

This slide is another comparative slide basically showing the differences between the wet year and a normal year or historic years, which is the straight line. And then it shows -- the dry years scenario shows how much the runoff drops off in the springtime period. And you can see here again in the wet scenario that there's not much difference during the summertime in terms of runoff between the two scenarios, historic and the wet.

This one shows -- this particular slide shows the range of runoff that we're looking at. This line is -- zero represents the average year for each scenario. So what I'm looking at here is this particular line shows how much the wet year runoff can vary from the average for that scenario.

And you can see that the wet year ranges are very large. They're basically this line right along there. So that you're getting runoff differences, it could be 18,000 acrefeet above the scenario average in the wet scenario, and 7000 acrefeet below in this particular case.

The historic average is this light gray shaded area that is in this space here. You can see that actually the variation can be quite high in the spring for the historic average. And that you can see this is the dry year range, as well.

What's interesting is that in the dry scenario, the PCM scenario, this is the darkest area here. And it has the same variation as the average. Very close. Except it doesn't have the high spring runoff. You lose the high spring runoff years in the dry scenario.

And so again what you're losing here is potential hydropower generation during wet years in the dry case.

This is a slide comparing the dry years within each scenario. So what we have here, this line here shows what an average year in the historic scenario looks like. And you can see how it ends up peaking quite high in May and June.

This blue line is the historic dry year. This is 1976/77. And this is what the runoff looked in that particular year.

Under the proposed wet scenario this is what '76 runoff would look like, scaled up for the wetter Hadley scenario. And you can see that it goes up some in the wintertime, but then it falls back. And during the summertime it's virtually identical to what the historic was.

So again, when you have wet conditions,

even in the wetter scenario, the first thing is it's not even close to the average year. You can see that there's a substantial difference in the wet scenario between what we have for average conditions and what might happen under the wet scenario. The other thing is that runoff is again pushed earlier into the year.

Then the dry year scenario, the dry scenario, dry year scenario is this darker set down here. And you can see that it is very close to what has happened historically. And again there's this large decrease in the spring and summer period again. That would be lost hydropower generation.

So, what I'm going to talk about now is the configuration of the hydropower system. And the first thing to look at is where's the reservoir capacity. That is, where is the ability to capture water as it's coming down the mountain.

What we have is this is the capacity that's above 4000 feet; this is between 3000 and 4000, between 2000 and 3000, from 1000 to 2000 feet and then this is from sea level to 1000 feet.

There's 17 million acrefeet of storage in the state between sea level and 1000 feet.

That's Shasta, Folsom, New Melones, Don Pedro, Oroville. You can go on. There's a lot of major reservoirs that are here.

This capacity is here to deliver water and to provide flood control. That's the two primary purposes of this capacity. This capacity, as you go up the mountain, it becomes more and more related to hydropower generation. But you can see that the scale is relatively small farther up the mountain, a couple million acrefeet in each one of these individual segments.

I want you to remember this relationship because I'm going to now turn to a slide that shows how the generation capacity is split out among these same segments.

And you can see here that while we have 3000 megawatts of generation capacity in this lower segment, we also have a large amount above 4000 feet. We have 2000 megawatts above 4000 feet. We have 2300 megawatts, so you can illustrate, this is how this distribution looks for reservoir capacity, this is what the distribution looks like for generation capacity.

The generation capacity is spread much more up the hill. And so that you don't have --

much of this generation capacity is unsupported by reservoir capacity, or has much less support than generation capacity. And that's because it relies on snow melt to provide the water in order to run through the turbines. And it's counting on snow melt coming down in May and June for this particular generation capacity.

If you have an earlier shift in the snow melt you lose the ability to use this generation capacity to the same level in the July/August peak period.

Then what you can see, you can also see how much energy is generated in each elevation segment. And when we go to this calculation we see that, in fact, even though there's 17 million acrefeet of storage at this level, it's not the place where you get the most hydropower generation. You actually get it here at 1000 to 2000 feet, and there's only 2 million acrefeet of storage at this level. Two million here, 17 million here. So a lot of this energy production, almost the majority of it is coming from snow melt, from the snow melt reservoir -- snow pack reservoir. And the timing of it is determined by when that snow runoff is coming down the hill

And then finally you can see how the amount of energy production there is per megawatt that is coming from the various levels. And as you go farther up the hill until just before you get up to the highest level you can see that the amount of energy that you get per megawatt of capacity increases as you go up the mountain.

And that's because of the design, the steepness of the Sierras. You get much higher hydraulic -- as you go further up the mountain, the penned stocks are longer, the hills are steeper. And so you're getting more bang for your buck out of your generation capacity at the higher elevations.

So what we did is then we looked at the scenarios by river basin. And what we were looking at is comparing the amount of generation capacity that was in each one of these river basins against the potential changes in runoff from the two different scenarios.

The first thing is the scenarios are shown, this is the wet scenario. And it shows how much the runoff should increase, or might increase relative to the historic average for each one of these river basins. The river basins are arranged from north to south. This is Trinity River, the Sacramento. We work our way down south, down to the Kings, where the Helms River is, Kern, Bishop Creek and Owens, which are over in the Mono Lake area. So we're working from north to south.

And you can see that the change in the runoff increases as you go further south. Probably has something to do with the fact that the runoff, in total, decreases as you go south. So there's potentially more variation as you move south. But it's somewhat of an artifact of the model, as well, and the implications of that model.

You can see this is the dry scenario down here. And you can see how much the runoff decreases under each one of the -- in each one of these river basins. And it decreases -- again, there's some trend as you move farther south. Not as significant as there is one up here. But, again, it's averaging around 25 percent decrease in runoff in each one of these.

And then over here is the list of capacity by river basin. And we have the Sacramento and the Feather and the American which have large amounts of capacity, along with the San

Joaquin.

Sacramento includes, this includes PG&E's Pitt River system; the Feather has both PG&E and DWR. American has a number of different operators on it. San Joaquin is Edison and PG&E. And then the Kings, this is actually dominated by the Helms power plant.

There's not a lot of capacity beyond Helms. One of the things to think about Helms is it's operation actually won't be affected very much by this because it actually only has about a 2 percent capacity factor. It's moving water up and down the hill. And it just needs a pool of water at the bottom. So runoff doesn't affect Helms' operations much.

But it does affect these other rivers. And the rivers of greatest interest are these four right here, the Sacramento, Feather, American and San Joaquin, based on the capacity, amount of capacity in each one of these river basins.

Then as I talked about earlier, how the change in runoff relative to the reservoir capacity is also an important parameter, because that affects your ability to manage these flows in some way.

Again, we have the wet scenarios versus the dry scenarios. And what this shows is the proportion of -- the variation relative to the proportion of reservoir capacity. And there's more discussion of it in the report. It's a little bit of a complicated concept, but you can see that, for example, on the San Joaquin, what this means is there's not much reservoir capacity. But that the runoff variation is relatively large.

So, on the San Joaquin there is going to be more problems handling variations in stream flows than in any of the other particular river basins that we're looking at.

The American and the Yuba River systems, also they have relatively small storage capacity compared to the amount of runoff variation there is. And these bars tell you the relative sizes of the reservoir capacities. You can see that the Sacramento and the Feather, the Stanislaus and the Tuolomne have relatively large amounts of reservoir capacity. And you can see they have, the Stanislaus and Tuolomne in particular have relatively good ability to handle the variations in runoff, and variations that may occur under climate change. But that's not true for some of these other reservoirs that we talked about.

So what we did is based on that analysis looking at those two measures of stream flow variation compared to generation capacity and reservoir capacity, we were looking at criteria for identifying what are the most important river basins to look at for future study.

And so we were looking for ones that have large amounts of generation capacity that were dependent on runoff. And that's the Sacramento, the Feather, as we mentioned, on the American, and the San Joaquin.

We also were looking for where there were reservoir capacities that were small relative to potential changes in runoff. As I mentioned, for example, the San Joaquin.

And then also the -- excuse me -- the river basins that are most important to the state for specific purposes. And that's, for example, the Feather River, where PG&E uses that particular set of facilities for meeting ancillary services needs, doing daily load following, providing reserves spinning reserves.

And then finally, looking at the ones that are most important to the state and are going to be most affected by potential climate change going forward. And so based on that, we were looking basically for the four basins that were canaries in the coal mine, as we said. The ones that as we see changes in operations, these would probably be the best indicators for how the rest of our hydropower system is going to be impacted.

And those four that we got merited future analysis in more depth were the Sacramento and Pitt Rivers, the Feather River, the American River systems in which there is actually PG&E and U.S. Bureau of Reclamation and SMUD all have systems on that particular river basin; and the San Joaquin River, where PG&E and Edison have large hydropower systems. So those were the ones that we identified as candidates for further analysis.

And so this breaks out the hydropower capacity by elevation for each one of these particular river basins. And you can see, for example, the San Joaquin has quite a bit of capacity evenly distributed across the different segments. And so it has some of it further up the mountain.

The American also has a relatively even

distribution of generation capacity by elevation. The Feather has a large amount, if you look at these top four segments, actually has a large amount in comparison to the other two river basins here. And this is Oroville, is at the bottom of this particular reservoir. So that's the generation capacity that is there.

The Sacramento had actually most of its capacity located on the lower, below 4000 feet. And Shasta and some of the Pitt River system are here at the lower elevations. But it would be -- it also has a large amount of generation capacity, so it's important to the state in terms of providing energy.

So, to sum up our findings from the analysis that we've done, there is a warming trend that is going on in California from the evidence that we have. What's causing it is still open to question. But the fact is that we're expecting more changes in the climate, and that we probably want to look at different ways of adapting to that change over time, given the way that things are currently structured.

Hydro is not a large resource in aggregate relative to the state; it's 15 percent of the energy production. And it's going to be a decreasing percentage in the future. But it still is an important resource for the state, because it provides a lot of the peaking capacity for the state and various other services.

For some municipal utilities, for example SMUD, Modesto, Turlock, hydro is a very important energy resource. And the variation in the energy resource can greatly affect their ability to meet their own loads.

And then the other important thing that we really didn't look at in detail in this report, but requires further study, is that the variation in the Pacific Northwest is actually going to disproportionately affect California. And that's because for the Pacific Northwest, what they sell is they sell us the residual hydro capacity. They take their hydro energy first, and then sell us what remains.

Well, if for example, the average production in the Pacific Northwest fell from 16,000 average megawatts to 12,000 average megawatts, California would probably lose most of that 4000 megawatts. Most of that 4000 megawatts would be taken out of California sales. And the

Pacific Northwest would retain almost all of that 12,000 average megawatts. So that California is disproportionately affected by the regime changes in the Pacific Northwest.

Another important finding that we want to emphasize is that the purpose of the water storage and the hydro facilities is elevation-dependent. Depends on how high up the mountain. The lowest ones down are for flood control and water storage, not for generation capacity.

That generation capacity tends to be situated higher up the mountain than the reservoir storage capacity, so there is some independence between the two of them.

The snow pack is an important reservoir that brings down the water in a particularly timed way in order for us to be able to exploit it to generate electricity. If we change the timing of that runoff, if that's changed in some way so that we're getting that water down in the winter, late winter instead of the late spring, that affects our ability to meet peak loads during the summer, and diminishes our ability to use hydrogeneration at the appropriate times.

And there's really some further studies

that we should probably look at, given the findings from this and from other work that's been done.

One is looking at how changes in runoff at different elevations affects the hydropower generation. We weren't really able to look at how the capacity at the top of the mountain was affected by changes in snow melt rates, because we don't have that data yet. And that's a really important step in understanding how the hydropower system will be affected.

And then looking at how hydro output will be changed by this changes in runoffs. That's another piece of analysis that would be important.

And then finally looking at how flood control, hydropower generation, water supply and recreation needs all are going to have different kinds of tradeoffs in the future. We have a fairly rigid set of rules particularly related to flood control and reservoir management. And those rules probably can't accommodate the ranges that we're looking at. And that's one of the things that we should probably start down the road on because it's going to take a fair amount of time in order to change those.

So, given that, I want to turn it back over to Suzanne, who's going to look at how other agencies have studied or looked at this issue, or not looked at this issue.

COMMISSIONER BOYD: Richard, before you get away, let me ask you if the consensus of the scientific community relative to California were that we were, the range is shifting more towards the drier side, which I really think was the consensus of the work of scientists that was published in the Journal of the National Academy, the same scientists, many of whom are on, you know, who work for us in our PIER program. Would that just exacerbate all that you've told us about today?

DR. McCANN: Oh, right, that's -- well, we were looking at the dry scenario as well as the wet scenario in order to look at the potential impacts. And when you look at the dry scenario that's one of the things is that, as we pointed out in one of the earlier slides, the runoff still comes in a narrower time period.

I could probably go back and find the slide, but what happens is you still have the same amount of monthly runoff in January, February and March as you do in a historic average. Where you get the drop off is in the December and in April and May relative to what you have now.

And so you still have the same flood control problems that you have now, because you would typically have about the same amount of runoff coming down the mountain in February. Your problem is that you have no runoff after March to support your hydropower generation system. Or even, it actually creates problems for water supply, as well.

And that's happening because you have accelerated snow melt.

COMMISSIONER BOYD: I don't know if you or Suzanne or Guido have been able to even see the letter submitted by Professor Hanemann for the docket on this report, but he, of course, is one of our major PIER scientists with whom we've worked very closely lately.

He expressed quite a bit of concern about our analyses on this subject. So I don't expect to get into that in detail today, but that's obviously something we're going to have to take into consideration. Of course, he was one of the scientists who participated in the update of view of California that was indeed published last year by the National Academy. And one which analysis we're working with, and which analysis is affecting the thinking in this Administration about climate change and so on and so forth.

So, certainly we're going to have to take that into account and try to have the most up-to-date view of things in our 2005 IEPR as we can get. So I just put that -- put everybody on notice that we do need to dig into this --

DR. McCANN: Right, we --

COMMISSIONER BOYD: -- before we final this.

DR. McCANN: The runoff scenarios weren't available from them in time for this analysis.

COMMISSIONER BOYD: I agree. The concern is that, our problem, as an agency, is to be, you know, to be caught up with the rest of the policy decisions that are going on in this state relative to the subject of climate change in the information we put forward. So, there's -- I think there's a lot of discussion we're going to have to have on this.

DR. McCANN: Yeah, and I've been working with Dr. Hanemann on this topic up to this point, as well. We've had discussions about further analysis.

So I'll turn it over to Suzanne. Thank you.

DR. PHINNEY: Oh, I see my alphabet soup slide is already up. We did a survey of hydro operators and planning entities to determine -- to see how they were or were not incorporating climate change. And contacted over two dozen agencies and utilities and water districts, et cetera. I'm not going to go through all of these, but we did look at the western U.S. electricity groups, and California, energy-related state agencies, water supply operators, the utilities and then the irrigation districts and the munis.

And the Pacific Northwest, a number of entities, themselves, and in the Colorado River Basin. It was hard to find people to talk to in the Colorado River Basin. I think that sort of reflects their interest in the subject.

What the results of the survey showed is that most of the entities, most of the people are tracking the studies. And the degree to which they track the studies can reflect how they use, to the extent that their focus is on hydropower.

So, you know, jumping down to the third bullet, the IOUs have the most aggressive program. PG&E and Southern California Edison, because they rely on the hydropower to a great extent for electricity production. And they're not in the water supply or flood control business.

However, even though the folks are tracking the studies, very few, if any, are actually including global climate change in their planning documents. And as I recall there were a few, practically no actual changes to hydropower operations at this point in time with respect to global climate change.

Uncertainty is a big factor in the fact that they're not being included because people aren't quite sure whether to go for a wet scenario or a dry scenario. And the numbers are still sort of very broad. We're not at that stage where you can actually identify specific changes, and particularly to local watersheds. And that will be part of the future research.

I will make an editorial comment that I think the states, particularly California, Washington and Oregon are the most involved in this issue and doing the most research. And certainly well ahead of the federal government.

In some of my discussions federal agencies don't even call it climate change. They just refer to it as climate variability. And indicate that they are not doing very much in this particular area. I won't ascertain as to whether that's politically driven or not.

PRESIDING MEMBER GEESMAN: Suzanne, did your survey include BC Hydro?

DR. PHINNEY: Yes.

PRESIDING MEMBER GEESMAN: And would you characterize --

DR. PHINNEY: They are --

PRESIDING MEMBER GEESMAN: -- their response?

DR. PHINNEY: They are tracking it. I don't believe that they've actually made any changes to their operating plans. But a lot of those northwest entities are working with the Northwest Power and Conservation Council that actually has done some modeling. And will continue to do some. But that modeling has not translated into their five-year plan.

And some of this is that most of these folks don't do really long-range planning. And certainly the hydro operators, those people who are at the reservoirs, you know, maybe plan a year in advance. So, there doesn't seem to be also the mechanism to allow for that very long-range view.

And then the last thing we looked at was whether climate change would impact coastal power plants. And what we mostly encountered was a lack of data. The studies show that climate change could very well cause a rise in sea level and an increase in storm intensities and frequencies.

And that sea level rise, whether it's attributable to climate change or not, probably more attributable to it, is already occurring. For example, up to eight inches in California. Some of the studies project up to a meter increase by 2100.

But in looking at a few select plants, we really weren't able to find any information on sea level rise. One of the studies indicated that the Oxnard Plain might be particularly susceptible to sea level rise, so we contacted the Ormond Beach and Mandalay Bay -- that's right, yeah, Mandalay, maybe, I'm thinking Las Vegas now --

(Laughter.)

DR. PHINNEY: -- facilities, and they weren't even tracking this issue, weren't aware of any particular effects.

And then we also looked into whether storm intensity and frequency could cause impacts. And the biggest finding there was that it could affect the Diablo Canyon Power Plant in that they already have to reduce power significantly when heavy storms increase the debris in the water intake facilities. And probably about twice a year they have to go down to 20 percent power, those steam generators.

And if more storms, more winter storms coming from the northwest were to increase that would continue on unless there were changes made to the intake structure.

So, I think that concludes our presentation.

MR. TRASK: So, bear with me, let me load up Guido's presentation here.

DR. HOUSE: Could we have comments now on what we just talked about?

PRESIDING MEMBER GEESMAN: Yeah, go ahead, Lon.

DR. HOUSE: Okay. I think they did a good first order analysis, but there's something else I wanted to alert you to that's becoming an increasing problem. And it has to do with what Richard was talking about, is the elevation.

The big water storage facilities are at about 1000 feet or below. And these are, as Richard showed you, they have large volumes of water but they're very broad and typically pretty shallow.

The consequence of that means that the water heats up. The other consequence of having these facilities is they block the passage of the fish to the upper levels. And so in almost all cases what you have is you have a temperature requirement below these lower level reservoirs that is in -- for the salmon spawning and the trout -- that's in the 50- to 60-degree range.

The problem is that if we don't get water, water agencies in particular, don't get cold water coming from up above they can't meet their water temperature requirements down below.

So, what you're seeing is, and they talk about there weren't operational changes and like that, they may not have instituted operational changes, but they did institute physical changes. Because you see a water curtain going in in Shasta; you're seeing it going in in Oroville.

And the problem is if we end up with a climate change that doesn't provide cold melt water throughout the summer that gives us a large pool of cold water in these lower level reservoirs, in order to get down to that cold water at the bottom of the reservoir we end up bypassing the generators.

And so this is just a secondary level effect that it's dependent upon. Not just the flow of the water that's coming off the mountains, but it depends upon the temperature of the water. And if that water's not cold enough you're going to see decreased generation, even though you've got the water. But you'll see decreased generation from the lower level reservoirs in the late summer and early fall due to temperature requirements.

PRESIDING MEMBER GEESMAN: That makes sense. And I would think that a researcher would be able to quantify that impact, or establish scenarios by which one could quantify that impact.

DR. HOUSE: And I think it would be

something that would be good for you guys or for somebody to look at. Because right now it's being done on a piecemeal-by-piecemeal basis because the water guys, like from Mokelumne. We know what the temperature is that we have to release throughout the year.

And like I say, that's why they're putting the water curtains in in these big federal storage dams so that they can get down to that minimum pool of cold water. The problem is it bypasses the generators when you get down to that -- when you have to go to the very lower levels of that water release.

Thank you.

PRESIDING MEMBER GEESMAN: Thank you. Jim McKinney, you might give some thought to how we might get a handle on that, perhaps with Fish and Game or Fish and Wildlife Service, to better bound some future study that could put some numbers to that.

MR. McKINNEY: Yeah, I really agree with what Lon just said. And we're seeing it on the current FERC licensing cases. And there's just not enough cold water at the right times of the year to meet the fisheries needs, whether it's for salmonids or native trout or amphibians or what-have-you.

Yeah, and before Guido comes up, or if we have other audience comments, I just want to make my suggestion for additional research, which is in the environmental area.

I also think that we did a nice first step in, I know, applying some of the PIER work to hydroproduction. But in my discussion with federal agencies who have some of the laboratories that could really do comprehensive studies on the effects of climate change on inland rivers and streams, I think as Suzanne alluded, the Forest Service doesn't do climate change. And they really got the best structure to look at this stuff on any large scale.

So I think there's an opportunity for the state to add value on some of the scientific work. And I also think FERC's response was, to our questions by Suzanne, was why do you want to know and our attorneys will get back to you on that.

(Laughter.)

DR. PHINNEY: We haven't heard yet.

PRESIDING MEMBER GEESMAN: Yeah, I guess

the thing I'm left with, as well, and this is an unquantified and perhaps unquantifiable response. But it seems to me that at least on the California electricity system, depending on your temperature scenario the impact on electricity demand might be much larger in terms of peak megawatts of demand than any of the supply side impacts that you've studied.

And I don't see anybody from our electricity demand office here. If there's anybody listening in the building you might make note of this for your work plans for the next cycle.

I think we need to get a better handle on those demand side impacts, because I think they will only exacerbate all of the problems that you point out with the hydro system.

MR. McKINNEY: I agree. We like to stay within our cubicle walls at the staff level.

PRESIDING MEMBER GEESMAN: Yeah, I've noted that.

MR. McKINNEY: We're trying to get over them, but --

Were there any other commenters from the audience? If not, let me invite Guido Franco to come up and talk about his portion of this.

MR. FRANCO: Commissioners, Advisors, I want to first thank Jim for inviting me to give a short presentation about the work that we are sponsoring, and actually the PIER program of the Commission is sponsoring.

We started with some initial work that culminated with the publication of the report in 2003. We developed the (indiscernible) that were used by Richard for his study, used heavily in the PCM. And we sponsored exploratory study of the potential implication of climate change on water sources, including hydropower that were reported here today.

But after the first study that we sponsored we suggested to the R&D Committee and to the Commission that it would be a good idea to create a climate change resource center. Because there are multiple aspects of climate change that involves multiple disciplines.

So the Commission has created a resource center on climate change. It started this work like a year and a half or more ago. We have worked on climate analysis and modeling at Scripps, (indiscernible) and Berkeley. We're doing work on carbon sequestration.

We also have a program looking at competitive solicitations. That is where we fund projects that are designed to complement work -- other branches of the Center.

With respect to ongoing work, we are in conjunction with Cal-EPA, Air Resources Board and other state agencies, preparing a preliminary assessment report that's due to the Governor in January 2006, where we are looking at different aspects of climate change and potential impacts. We're going to be collaborating with them to generate every two years an update to this report.

In addition, we are also developing what we hope to achieve as a probablistic kind of projection for California. And work with Scripps, UC Berkeley and UC Davis we are funding a local search on climate change and water resources including hydropower.

With respect to probablistic climate projections, I've heard there is a consensus that by different Calvin models that temperatures will increase in California. But there is no consensus with respect to precipitation. So, as indicated before, some models say yes, that precipitation would go up, while other models suggest that precipitation would go down.

However, there are, again, temperatures and sea level rise and things that will happen in California.

So what we're trying to do is to develop probablistic climate projections for California. I'm going to talk a little bit on how we are planning to do that.

In part, we're going to be doing that with some information that we're obtaining for a project with Dr. Ben Santer, Tom Wigley and Phil Duffy on climate (indiscernible) attribution. This means, I mean climatization means what changes are already occurring in California.

And those changes -- what portion of those changes are viewed to climate change and what portion is viewed to natural variability.

If we're able to untangle what is viewed to climate change and what is viewed to natural variability we may be able to develop more realistic climate projection for California. This is an extremely difficult work. As far as I know this is the first study that's looking at climate (indiscernible) attribution at a regional level.

It has been done at a global level but at the regional level it hasn't been done before. But if somebody can do it, it would be the group I mentioned before, Ben Santer and Tom Wigley. They are two of the world leading experts in this area of work.

Just to give you an example with respect to climate (indiscernible), a recent report published in 2005 suggests that April 1st snow levels in the western United States are in general declining. But there are some increases, mainly in the southern portion of the Sierra Nevada. Are these trends, or if they are trends, it means that we may get more snow there, but at the same time, this is just part of the natural cycle. The trend may reverse itself.

Aerosols. Recent observations indicate that aerosols have played a significant role on precipitation. There is some work, for example, in suggesting that in California aerosols are decreasing the precipitation by about 10 to 15 percent. This is a significant amount of -- a significant reduction.

And what we're doing right now is we're funding some work by Dr. Wigley and Professor

Rosenfeld to using both satellite data on a research aircraft, trying to find out what role -- I mean if we can confirm that aerosols are having a negative effect on precipitation in California, especially in high elevations. And if we can demonstrate that, I mean, if there's a way to quantify the relationship between aerosols and precipitation. If we are able to achieve this, I think this again will be used to better bracket our future climate projections.

We also, as mentioned before, global circulation models are all over the place. We recently studied (indiscernible) climate projections that have been developed for the fourth assessment report of the intergovernmental panel on climate change. Again, there are some models that suggest that California will be wetter; although most of California will be drier.

However, what nobody has done so far is to take a look at the global models with historical data, and find out which one of those models are doing an adequate work or job for California. And that's work that we're going to start in the very near future. It's time to be more selective with respect to the models.

It may be that, for example, models that simulate really wet conditions for California are really over-emphasizing or over-estimating the amount of moisture coming from the Pacific to California and to the west coast. And again, Dr. Tom Wigley, a professor in UC Santa Cruz, is involved in this work.

And we are also taking a closer look at regional climate models. I mean -- assured that the models that we use for our climate projections are doing a good job when we provide realistic boundary conditions to those models to estimate what will happen in California.

We are also developing detailed hydrologic projections. Some of the things that regional management that will be needed to better estimate the potential impacts of climate change on hydro generation. In this case, for example, the Scripps is testing the use of hydrological models, but even by historical data and by climate change predictions, a statewide model to look at the potential changes in runoff on different elevations. The results will have adequate temporal and geographical resolution for impacts and -- studies.

With respect to in general what the resources on climate change, we are working with two groups. One is UCDavis, we're enhancing the carbon model. There are some for the preliminary work that we funded the researcher had to make some simplifying assumptions. We are improving that model to make it more realistic, but still would be an engineering optimization model.

And the idea of using the carbon model is to look, if we modeled the entire water system the model can give us -- could suggest to us a good adaptation strategies.

At UCBerkeley, they're developing a simulation model for a water system in California. And what they will do is, I mean a simulation model, what it does is to simulate current conditions, the gross operation, et cetera, et cetera. And they will do it relaxing the rules to find out what relaxations will provide the best options toward that to climate change. And some of the suggestion will come from the runs of the CALSIM model.

And we're starting the new study on the potential impact of climate change on the power. For example, the CALSIM model we're going to be adding more and more hydro units in the CALSIM model.

But in addition to looking at impacts, we're also looking at adaptation options. Here I have a list of studies that we're conducting. One of them has to do with the Inform project that you may know about it. The Inform project is a project that's headed by Professor Kosta Georsakakos. He's also associated with Scripps. And he showed in a paper published, I think, in 2003 that using -- probablistic forecasts that -- this is a (indiscernible) system -- that he could improve the operation of the current reservoirs. That will still avoid flooding, increase power generation, will have more water for consumption.

And it was very convincing, in my opinion, paper. And since then the Department of Water Resources, I believe the U.S. Bureau of Reclamation, the PIER program and others are -- CalFed -- are funding demonstration of this type of systems using (indiscernible) forecast for the managing of water reservoirs.

And why is this related to climate change? It's related to climate change because the subsequent paper also showed that using the same type of system we'll be able to better cope with increases in (indiscernible) due to climate change; regardless if it's a dry or wet scenario.

With Scripps, and the funding with NOAA, we also create a project entitled, Cal Energy Security Project. That's more or less the same thing. Use of probablistic forecast for energy management purposes.

There's a project of Joe O'Hagan, a colleague of mine, just started it, that will continue this type of work, and getting the -- study to adapt to climate variability now, we're going to be better able to cope with climate change in the future.

We'll also be working with Calvin models and the models being developed by UCBerkeley to look at potential adaptation options. And they are all the studies underway.

Potential future initiatives. A Professor Ramanathan from Scripps gave a keynote talk last year in our first conference on climate change. And he suggested that transport of black carbon from Asia may be impacting snow levels, or may be depositing in the snow in the high elevations, changing the reflectivity of the snow.

That seems trivial, but in fact may be in some way contributing to the early onset of snow melting.

It hasn't been proven yet. Again, the PIER program would be the first one that will look at the study -- will study this effect and see if it is important (indiscernible), and if it is, I mean, what to do about it.

The CALSIM model also suggests that underground aquifers could be used as a storage units to negate, in part, the increasing climate variability that (indiscernible) from climate change. We need to enhance the existing models, including the CALSIM model, to improve the (indiscernible) of groundwater aquifers.

The only problems that we're facing is that we need to better characterize the resource. I mean there are physical limitation of the knowledge that we have about the system that we need to improve. And I think it's work that we need to undertake now.

With that I will thank you for letting me give you a very short presentation regarding the work we're doing related to this work.

Thank you.

PRESIDING MEMBER GEESMAN: Thank you,

Guido.

MR. McKINNEY: Commissioners, that concludes staff's presentations on this subject area. And if you have any closing comments or if there are any last comments from the audience or anybody on the phone.

PRESIDING MEMBER GEESMAN: Anybody in the audience or on the phone care to make any remarks?

DR. HANEMANN: This is Michael Hanemann on the phone. I wonder if I could say something very briefly.

PRESIDING MEMBER GEESMAN: Yes, please go ahead.

DR. HANEMANN: Well, I really appreciate the opportunity to address you remotely. I just want to make four brief points.

One is that in my own view the distinction of the significance of wet versus dry models tends to be exaggerated with regard to its significance to the California water supply, and also energy.

As you know, most of the precipitation occurs in the winter in California. Most of the water use in California occurs in the spring and summer. My estimate is that about 80 percent of all the water used in California is used between April and September.

Without extra storage it makes no difference whether there's increased or reduced precipitation in the winter because we have no means of turning that to effective use.

Obviously it's important to consider additional storage, including conjunctive use. But the point is we have surplus water in the winter months anyway right now. And so a wet model versus a dry model makes very little difference in practice.

Temperatures are a much more crucial variable for the reason that Richard McCann and others mentioned, because that controls the fate of the snow pack, which holds about as much water as the major man-made reservoirs in the state.

And all of the models are unambiguous that the temperature will increase. And an increase in temperature means we lose the snow pack. We lose some portion of the snow pack.

Second point has already been raised. The analysis that was used in the staff report comes from the 2003 PIER report, which in turn uses global climate models of a vintage of 2000, which were developed for use in the 2001 IPCC report.

As I mentioned in my written comment, there's now a new generation, a new vintage of these models, some of which became available 18 months ago. And all of which are now available for use in the fourth IPCC report.

And the models we have looked at so far show a sharp increase in summertime temperature compared to the previous generations of these models. Very roughly they show twice the increase in the summertime temperature than the previous generations of these models showed. And that is an important difference if it comes to be.

Rich McCann did an excellent job of describing the qualitative problem and that analysis still holds. The increased warming in the spring and in the summer means that the snow melt occurs earlier in the year. Literally instead of April, it may occur in February or certainly March.

The peak demand for energy is in the summer, and with the hotter temperatures there's likely to be a major increase in demand for energy, in agriculture for groundwater pumping, and in urban areas for space cooling.

And this change shifts when we have the maximum runoff of hydropower generation from when we have the maximum need for energy. And so it exacerbates the problems of timing.

The last point I want to make is a brief one, but I think needs to receive attention. And that is for understandable reasons in any agency I think the coordination between the climate folks and the energy report folks within the Energy Commission needs to be improved.

The data from the paper published in the PNS last August that could have been translated into predictions of runoff at high elevation sites where the hydropower reservoir at any time in the past 12 months. And it wasn't done because understandably the PIER folks didn't have enough funding to cover hydropower and energy work.

And I think the folks working on the 2005 Energy Report didn't have enough funding to spend on climate change.

And I'm very concerned, given the Governor's request that the state agencies produce a report on the impacts of climate change next

January, that the work that Jim McKinney and Richard McCann and the others have done for this report be enabled to continue in the fall, so that it can be made consistent with the other components, the climate scenario approach, that's being adopted for the Governor's report.

And so that we can have increased cooperation of those looking at water, those looking at hydropower, those looking at the demand for energy in agriculture and urban areas, and those looking at the supply of energy in California.

And so I think the crucial thing is to expand, or to continue this effort in the fall so that we can get a better accounting by January of the impacts of climate change on the California energy sector.

Thank you very much.

COMMISSIONER BOYD: Thank you, Michael; appreciate your participation. Didn't know you were listening in. Certainly glad you had the opportunity.

PRESIDING MEMBER GEESMAN: Okay, are there any other comments?

Want to thank everybody very much for

hanging with us throughout the day. And you will hear quite a bit more from us on this topic.

We'll be adjourned.

(Whereupon, at 3:14 p.m., the workshop was adjourned.)

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CERTIFICATE OF REPORTER

I, PETER PETTY, an Electronic Reporter, do hereby certify that I am a disinterested person herein; that I recorded the foregoing California Energy Commission Committee Workshop; that it was thereafter transcribed into typewriting.

I further certify that I am not of counsel or attorney for any of the parties to said workshop, nor in any way interested in outcome of said workshop.

IN WITNESS WHEREOF, I have hereunto set my hand this 3rd day of July, 2005.